Instruction Manual
748213-S
April 2002

Model 755R
Oxygen Analyzer

ROSEMOUNT® Analytical

EMERSON™ Process Management

http://www.processanalytic.com

ESSENTIAL INSTRUCTIONS

READ THIS PAGE BEFORE PROCEEDING!

Rosemount Analytical designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you **MUST properly install, use, and maintain them** to ensure they continue to operate within their normal specifications. The following instructions **MUST be adhered to** and integrated into your safety program when installing, using, and maintaining Rosemount Analytical products. Failure to follow the proper instructions may cause any one of the following situations to occur: Loss of life; personal injury; property damage; damage to this instrument; and warranty invalidation.

- **Read all instructions** prior to installing, operating, and servicing the product.
- If you do not understand any of the instructions, **contact your Rosemount Analytical representative** for clarification.
- **Follow all warnings, cautions, and instructions** marked on and supplied with the product.
- **Inform and educate your personnel in the proper installation, operation, and maintenance of the product**.
- **Install your equipment as specified in the Installation Instructions of the appropriate Instruction Manual and per applicable local and national codes**. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, **use qualified personnel** to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Rosemount. Unauthorized parts and procedures can affect the product's performance, place the safe operation of your process at risk, **and VOID YOUR WARRANTY**. Look-alike substitutions may result in fire, electrical hazards, or improper operation.
- **Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury**.

The information contained in this document is subject to change without notice.

Teflon and Viton are registered trademarks of E.I. duPont de Nemours and Co., Inc.
Paliney No.7 is a trademark of J.M. Ney Co., Hartford, CT
SNOOP is a registered trademark of NUPRO Co.

Emerson Process Management

Rosemount Analytical Inc.
Process Analytic Division
1201 N. Main St.
Orrville, OH 44667-0901
T (330) 682-9010
F (330) 684-4434
e-mail: gas.csc@EmersonProcess.com

http://www.processanalytic.com

EMERSON
Process Management

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

DRAWINGS (LOCATED IN REAR OF MANUAL)

PREFACE

The purpose of this manual is to provide information concerning the components, functions, installation and maintenance of the 755R.

Some sections may describe equipment not used in your configuration. The user should become thoroughly familiar with the operation of this module before operating it. Read this instruction manual completely.

DEFINITIONS

The following definitions apply to DANGERS, WARNINGS, CAUTIONS and NOTES found throughout this publication.

DANGER

Highlights the presence of a hazard which will cause severe personal injury, death, or substantial property damage if the warning is ignored.

WARNING

Highlights an operation or maintenance procedure, practice, condition, statement, etc. If not strictly observed, could result in injury, death, or long-term health hazards of personnel.

CAUTION

Highlights an operation or maintenance procedure, practice, condition, statement, etc. If not strictly observed, could result in damage to or destruction of equipment, or loss of effectiveness.

NOTE

Highlights an essential operating procedure, condition or statement.

INTENDED USE STATEMENT

The Model 755R is intended for use as an industrial process measurement device only. It is not intended for use in medical, diagnostic, or life support applications, and no independent agency certifications or approvals are to be implied as covering such application.

SAFETY SUMMARY

If this equipment is used in a manner not specified in these instructions, protective systems may be impaired.

AUTHORIZED PERSONNEL

To avoid explosion, loss of life, personal injury and damage to this equipment and on-site property, all personnel authorized to install, operate and service the this equipment should be thoroughly familiar with and strictly follow the instructions in this manual. SAVE THESE INSTRUCTIONS.

DANGER

ELECTRICAL SHOCK HAZARD

Do not operate without doors and covers secure. Servicing requires access to live parts which can cause death or serious injury. Refer servicing to qualified personnel.

For safety and proper performance this instrument must be connected to a properly grounded three-wire source of power.

Optional alarm switching relay contacts wired to separate power sources must be disconnected before servicing.

WARNING

POSSIBLE EXPLOSION HAZARD

This analyzer is of a type capable of analysis of sample gases which may be flammable. If used for analysis of such gases, internal leakage of sample could result in an explosion causing death, personal injury, or property damage. Do not use this analyzer on flammable samples. Use explosion-proof version instruments for analysis of flammable samples.

WARNING

PARTS INTEGRITY

Tampering or unauthorized substitution of components may adversely affect safety of this product. Use only factory documented components for repair.

CAUTION

PRESSURIZED GAS

This module requires periodic use of pressurized gas. See General Precautions for Handling and Storing High Pressure Gas Cylinders, page P-4

CAUTION

TOPPLING HAZARD

This instrument's internal pullout chassis is equipped with a safety stop latch located on the left side of the chassis.

When extracting the chassis, verify that the safety latch is in its proper (counter-clockwise) orientation.

If access to the rear of the chassis is required, the safety stop may be overridden by lifting the latch; however, further extraction must be done very carefully to insure the chassis does not fall out of its enclosure.

If the instrument is located on top of a table or bench near the edge, and the chassis is extracted, it must be supported to prevent toppling.

GENERAL PRECAUTIONS FOR HANDLING AND STORING HIGH PRESSURE GAS CYLINDERS

Edited from selected paragraphs of the Compressed Gas Association's "Handbook of Compressed Gases" published in 1981

Compressed Gas Association
1235 Jefferson Davis Highway
Arlington, Virginia 22202

Used by Permission

1. Never drop cylinders or permit them to strike each other violently.
2. Cylinders may be stored in the open, but in such cases, should be protected against extremes of weather and, to prevent rusting, from the dampness of the ground. Cylinders should be stored in the shade when located in areas where extreme temperatures are prevalent.
3. The valve protection cap should be left on each cylinder until it has been secured against a wall or bench, or placed in a cylinder stand, and is ready to be used.
4. Avoid dragging, rolling, or sliding cylinders, even for a short distance; they should be moved by using a suitable hand-truck.
5. Never tamper with safety devices in valves or cylinders.
6. Do not store full and empty cylinders together. Serious suckback can occur when an empty cylinder is attached to a pressurized system.
7. No part of cylinder should be subjected to a temperature higher than 125°F (52°C). A flame should never be permitted to come in contact with any part of a compressed gas cylinder.
8. Do not place cylinders where they may become part of an electric circuit. When electric arc welding, precautions must be taken to prevent striking an arc against the cylinder.

DOCUMENTATION

The following Model 755R instruction materials are available. Contact Customer Service Center or the local representative to order.

748213 Instruction Manual (this document)

COMPLIANCES

This product satisfies all obligations of all relevant standards of the EMC framework in Australia and New Zealand.

N96

SECTION 1
DESCRIPTION AND SPECIFICATIONS

1-1 DESCRIPTION

The Model 755R Oxygen Analyzer provides continuous readout of the oxygen content of a flowing gas sample. The determination is based on measurement of the magnetic susceptibility of the sample gas. Oxygen is strongly paramagnetic while most other common gases are weakly diamagnetic.

The instrument provides direct readout of 0 to 100% oxygen concentration on a front panel digital display. In addition, a field-selectable voltage output is provided as standard. An isolated current output of 0 to 20 mA or 4 to 20 mA is obtainable through plug-in of an optional circuit board. Current and voltage outputs may be utilized simultaneously if desired. An alarm option is also available by way of a relay assembly that mounts at the rear of the case with a cable that plugs into the Control Board. Customer connections are available on this assembly.

The basic electronic circuitry is incorporated into two master boards designated the Control Board assembly and the Power Supply Board assembly. The Control Board has receptacles that accept optional plug-in current output board and alarm features.

1-2 RECORDER OUTPUT RANGES

Seven zero-based ranges are available with the Model 755R: 0 to 1%, 0 to 2.5%, 0 to 5%, 0 to 10%, 0 to 25%, 0 to 50%, and 0 to 100%. Each range is jumper selectable.

1-3 MOUNTING

The Model 755R is a rack-mounted instrument, standard for a 19-inch relay rack (Refer to IEC Standard, Publication 297-1, 1986).

1-4 ISOLATED CURRENT OUTPUT OPTION

An isolated current output is obtainable by using an optional current output board, either during factory assembly or subsequently in the field. The board provides ranges of 0 to 20 or 4 to 20 mA into a maximum resistive load of 1000 ohms.

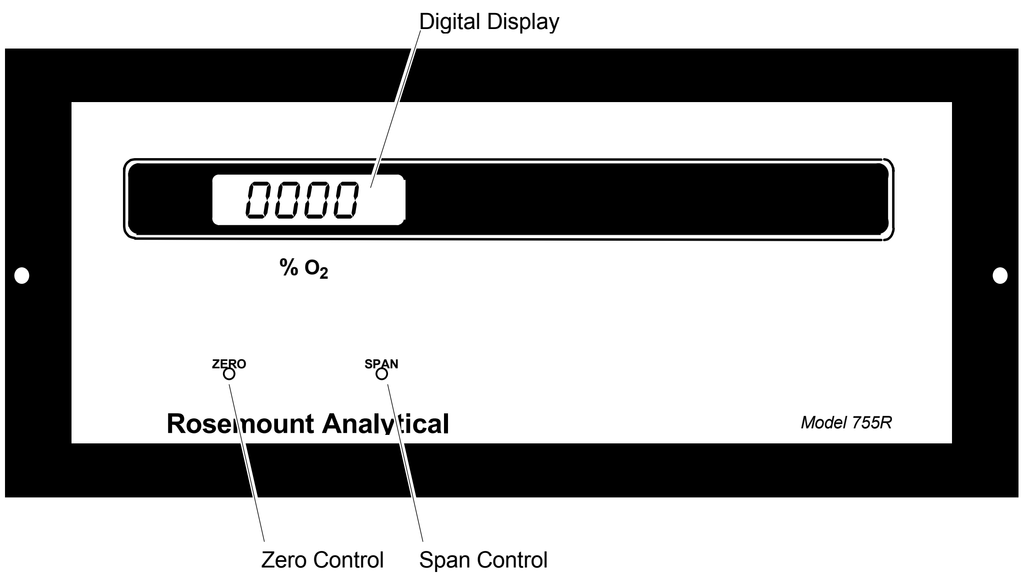


Figure 1-1. Model 755R Oxygen Analyzer – Front Panel

1-5 ALARM OPTION

The alarm option contains:

- An alarm circuit incorporating two comparator amplifiers, one each for the ALARM 1 and ALARM 2 functions. Each amplifier has associated setpoint and deadband adjustments. Setpoint is adjustable from 1% to 100% of fullscale. Deadband is adjustable from 1% to 20% of fullscale.

- An alarm relay assembly, containing two single-pole, double-throw relays (one each for the ALARM 1 and ALARM 2 contacts). These relays may be used to drive external, customer-supplied alarm and/or control devices.

1-6 ELECTRICAL OPTIONS

The analyzer is supplied, as ordered, for operation on either 115 VAC, 50/60 Hz or 230 VAC, 50/60 Hz.

1-7 REMOTE RANGE CHANGE OPTION

This option allows the customer to remotely control the recorder scaling. It disables the internal recorder fullscale range select without affecting the front panel display.

1-8 SPECIFICATIONS[1]

a. Performance

Operating Range (Standard)	0 to 5, 0 to 10, 0 to 25, 0 to 50, and 0 to 100% oxygen
Operating Range (Optional)	0 to 1, 0 to 2.5, 0 to 5, 0 to 10, 0 to 25, 0 to 50, and 0 to 100% oxygen
Response Time	90% of fullscale, 20 seconds
Reproducibility	0.01% oxygen or ±1% of fullscale, whichever is greater
Ambient Temperature Limits	32°F (0°C) to 113°F (45°C)
Zero Drift	±1% fullscale per 24 hours, provided that ambient temperature does not change by more than 20°F (11.1°C) ±2.5% of fullscale per 24 hours with ambient temperature change over entire range
Span Drift	±1% fullscale per 24 hours, provided that ambient temperature does not change by more than 20°F (11.1°C) ±2.5% of fullscale per 24 hours with ambient temperature change over entire range

b. Sample

Dryness	Sample dewpoint below 110°F (43°C), sample free of entrained liquids.
Temperature Limits	50°F (10°C) to 150°F (65°C)
Operating Pressure	Maximum: 10 psig (68.9 kPa)
	Minimum: 5 psig vacuum (34.5 kPa vacuum)
Flow Rate	50 cc/min. to 500 cc/min.
	Recommended 250 ±20 cc/min.
Materials in Contact with Sample	Glass, 316 stainless steel, titanium, Paliney No. 7, epoxy resin, Viton-A, platinum, nickel, and MgF2

[1] Performance specifications are measured at recorder output and are based on constant sample pressure and deviation from set flow held to within 10% or 20 cc/min., whichever is smaller.

c. Electrical

Supply Voltage and Frequency (selectable when ordered)	Standard: 115 VAC ±10 VAC, 50/60 Hz Optional: 230 VAC ±10 VAC, 50/60 Hz
Power Consumption	Maximum: 300 watts
Outputs	Standard: Field selectable voltage output of 0 to 10mV, 0 to 100mV, 0 to 1V, or 0 to 5VDC Optional: Isolated current output of 0 to 20mA or 4 to 20mA (with Current Output Board)
Alarm Option	High-Low Alarm
Contact Ratings	5 amperes, 240V AC, resistive 3 amperes, 120 VAC inductive 1 amperes, 24V DC, resistive 5 amperes, 30 VDC resistive 5 amperes, 120V AC, resistive 3 amperes, 30 VDC inductive
Setpoint	Adjustable from 1% to 100% of fullscale
Deadband	Adjustable from 1% to 20% of fullscale (Factory set at 10% of fullscale)

d. Physical

Mounting	19 inch rack (IEC 297-1, 1986)
Case Classification	General Purpose
Weight	46 lbs. (21 kg)
Dimensions	19.0 x 8.7 x 19.2 inches (482.2 x 221 x 487 mm) W x H x D

SECTION 2
INSTALLATION

2-1 FACILITY PREPARATION

Observe all precautions given in this section when installing the instrument.

a. Installation Drawings

For outline and mounting dimensions, gas connections, and other installation information, refer to Installation Drawing 654015 at the back of this manual.

b. Electrical Interconnection Diagram

Electrical interconnection is also shown in drawing 654015. Refer also to Section 2-5, page 2-6.

c. Flow Diagram

The flow diagram of Figure 2-1 (page 2-3) shows connection of a typical gas selector manifold to the Model 755R.

d. Location and Mounting

Install the Model 755R only in a non-hazardous, weather-protected area. Permissible ambient temperature range is 32°F to 113°F (0°C to 45°C). Avoid mounting where ambient temperature may exceed the allowable maximum.

Magnetic susceptibilities and partial pressures of gases vary with temperature. In the Model 755R, temperature-induced readout error is avoided by control of temperatures in the following areas:

1. Interior of the analyzer is maintained at 140°F (60°C) by an electrically controlled heater and associated fan.

2. Immediately downstream from the inlet port, prior to entry into the detector, the sample is preheated by passage through a coil maintained at approximately the same temperature as the detector (See Figure 4-3A, page 4-7).

3. The detector is maintained at a controlled temperature of 150°F (66°C).

Also, avoid excessive vibration. To minimize vibration effects, the detector/magnet assembly is contained in a shock-mounted compartment.

WARNING

POSSIBLE EXPLOSION HAZARD

This analyzer is of a type capable of analysis of sample gases which may be flammable. If used for analysis of such gases, internal leakage of sample could result in an explosion causing death, personal injury, or property damage. Do not use this analyzer on flammable samples. Use explosion-proof version instruments for analysis of flammable samples.

Use reasonable precautions to avoid excessive vibration. In making electrical connections, do not allow any cable to touch the shock-mounted detector assembly or the associated internal sample inlet and outlet tubing. This precaution ensures against possible transmission of mechanical vibration through the cable to the detector, which could cause noisy readout.

2-2 CALIBRATION GAS REQUIREMENTS

> **WARNING**
>
> **HIGH PRESSURE GAS CYLINDERS**
>
> **Calibration gas cylinders are under pressure. Mishandling of gas cylinders could result in death, injury, or property damage. Handle and store cylinders with extreme caution and in accordance with the manufacturer's instructions. Refer to GENERAL PRECAUTIONS FOR HANDLING & STORING HIGH PRESSURE CYLINDERS, page P-4.**

Analyzer calibration consists of establishing a zero calibration point and a span calibration point.

Zero calibration is performed on the range that will be used during sample analysis. In some applications, however, it may be desirable to perform span calibration on a range of higher sensitivity (i.e., more narrow span) and then jumper to the desired operating range. For example, if the operating range is to be 0 to 50% oxygen, span calibration may be performed on the 0 to 25% range to permit use of air as the span standard gas.

Recommendations on calibration gases for various operating ranges are tabulated in Table 3-1 (page 3-4) and are explained in Sections 2-2a (page 2-2) and 2-2b (page 2-2).

Each standard gas should be supplied from a cylinder equipped with dual-stage, metal diaphragm type pressure regulator, with output pressure adjustable from 0 to 50 psig (0 to 345 kPa).

Instrument response to most non-oxygen sample components is comparatively slight, but is not in all cases negligible. During initial installation of an instrument in a given application, effects of the background gas should be calculated to determine if any correction is required (See Section 3-4, page 3-1).

a. Zero Standard Gas

In the preferred calibration method, described in Section 3-4a (page 3-1), a suitable zero standard gas is used to establish a calibration point at or near the lower range limit. Composition of the zero standard normally requires an oxygen-free zero gas, typically nitrogen.

b. Span Standard Gas

A suitable span standard gas is required to establish a calibration point at or near the upper range limit. If this range limit is 21% or 25% oxygen, the usual span standard gas is air (20.93% oxygen).

2-3 SAMPLE

Basic requirements for sample are:

1. A 2-micron particulate filter, inserted into the sample line immediately upstream from the analyzer inlet.
2. Provision for pressurizing the sample gas to provide flow through the analyzer.
3. Provision for selecting sample, zero standard, or span standard gas for admission to the analyzer, and for measuring the flow of the selected gas.

a. Temperature Requirements

Sample temperature at the analyzer inlet should be in the range of 50°F to 150°F (10°C to 66°C).

Normally, however, a maximum entry temperature of 110°F (43°C) is recommended so that the sample temperature will rise during passage of the sample through the analyzer. This precaution prevents cooling of the sample and possible analyzer-damaging condensation. With a thoroughly dry sample, entry temperature can be as high as 150°F (66°C) without affecting readout accuracy.

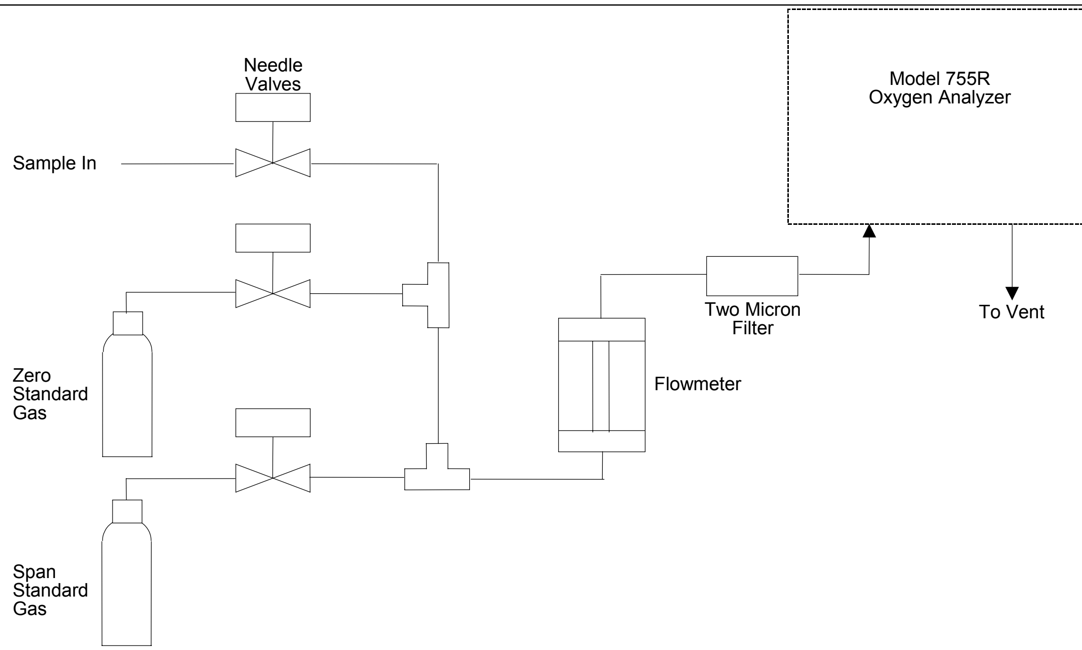


Figure 2-1. Interconnect of Typical Gas Manifold to Model 755R

b. Pressure Requirements - General

Operating pressure limits are as follows: maximum, 10 psig (68.9 kPa); minimum, 5 psig vacuum (34.5 kPa vacuum).

> **CAUTION**
>
> **RANGE LIMITATIONS**
>
> **Operation outside the specified pressure limits may damage the detector, and will void the warranty.**

The basic rule for pressure of sample and standard gases supplied to the inlet is to calibrate the analyzer at the same pressure that will be used during subsequent operation, and to maintain this pressure during operation. The arrangement required to obtain appropriate pressure control will depend on the application. When inputting sample or calibration gases, use the same pressure that will be used during subsequent operation. Refer to Section 2-3c (page 2-3), Normal Operation at Positive Gauge Pressures, or Section 2-3d (page 2-4) Operation at Negative Gauge Pressures.

c. Normal Operation at Positive Gauge Pressures

Normally, the sample is supplied to the analyzer inlet at a positive gauge pressure in the range of 0 to 10 psig (0 to 68.9 kPa).

> **CAUTION**
>
> **HIGH PRESSURE GAS CYLINDERS**
>
> **Pressure surges in excess of 10 psig during admission of sample or standard gases can damage the detector.**

Maximum permissible operating pressure is 10 psig (68.9 kPa). To ensure against over-pressurization, insert a pressure relief valve into the sample inlet line. In addition, a check valve should be placed in the vent line if the analyzer is connected to a manifold associated with a flare or other outlet that is not at atmospheric pressure. If the detector is over-pressurized, damage will result.

The analyzer exhaust port is commonly vented directly to the atmosphere. Any change in barometric pressure results in a directly proportional change in the indicated percentage of oxygen.

Example:

Range, 0% to 5% O_2.

Barometric pressure change after calibration, 1%.

Instrument reading, 5% O_2.

Readout error = 0.01 x 5% O_2 = 0.05% O_2.

Fullscale span is 5% O_2.

Therefore, the 0.05% O_2 error is equal to 1% of fullscale.

Thus, if the exhaust is vented to the atmosphere, the pressure effect must be taken into consideration. This may be accomplished in various ways, including manual computation and computer correction of data.

d. Operation at Negative Gauge Pressures

Operation at negative gauge pressures is not normally recommended, but may be used in certain special applications. A suction pump is connected to the analyzer exhaust port to draw sample into the inlet and through the analyzer. Such operation necessitates special precautions to ensure accurate readout. First is the basic consideration of supplying the standard gases to the analyzer at the same pressure that will be used for the sample during subsequent operation. In addition, any leakage in the sample handling system will result in decreased readout accuracy as compared with operation at atmospheric pressure.

The minimum permissible operating pressure is 5 psig vacuum (34.5 kPa vacuum). Operation of the analyzer below this limit may damage the detector, and will void the warranty.

e. Flow Rate

Operating limits for sample flow rate are as follows: minimum, 50 cc/min; maximum, 500 cc/min. A flow rate of less than 50 cc/min is too weak to sweep out the detector and associated flow system efficiently. Incoming sample may mix with earlier sample, causing an averaging or damping effect. Too rapid a flow will cause back pressure that will affect the readout accuracy. The optimum flow rate is between 200 and 300 cc/min.

Deviation from the set flow should be held to within 10% or 20 cc/min, whichever is smaller. If deviation is held to within these parameters and operating pressure remains constant, zero and span drift will remain within specification limits.

The analyzer should be installed near the sample source to minimize transport time. Otherwise, time lag may be appreciable. For example, assume that sample is supplied to the analyzer via a 100-foot (30.5 m) length of 1/4-inch (6.35 mm) tubing. With a flow rate of 100 cc/min, sample transport time is approximately 6 minutes.

Sample transport time may be reduced by piping a greater flow than is required to the analyzer, and then routing only the appropriate portion of the total flow through the analyzer. The unused portion of the sample may be returned to the stream or discarded.

f. Materials in Contact with Sample

Within the Model 755R, the following materials are exposed to the sample: 316 stainless steel, glass, titanium, Paliney No.7, epoxy resin, Viton-A, platinum, nickel and MgF_2 coating on mirror.

g. Corrosive Gases

In applications where the sample stream contains corrosive gases, a complete drying of the sample is desirable, as most of these gases are practically inert when totally dry. For corrosive applications consult the factory.

2-4 LEAK TEST

WARNING

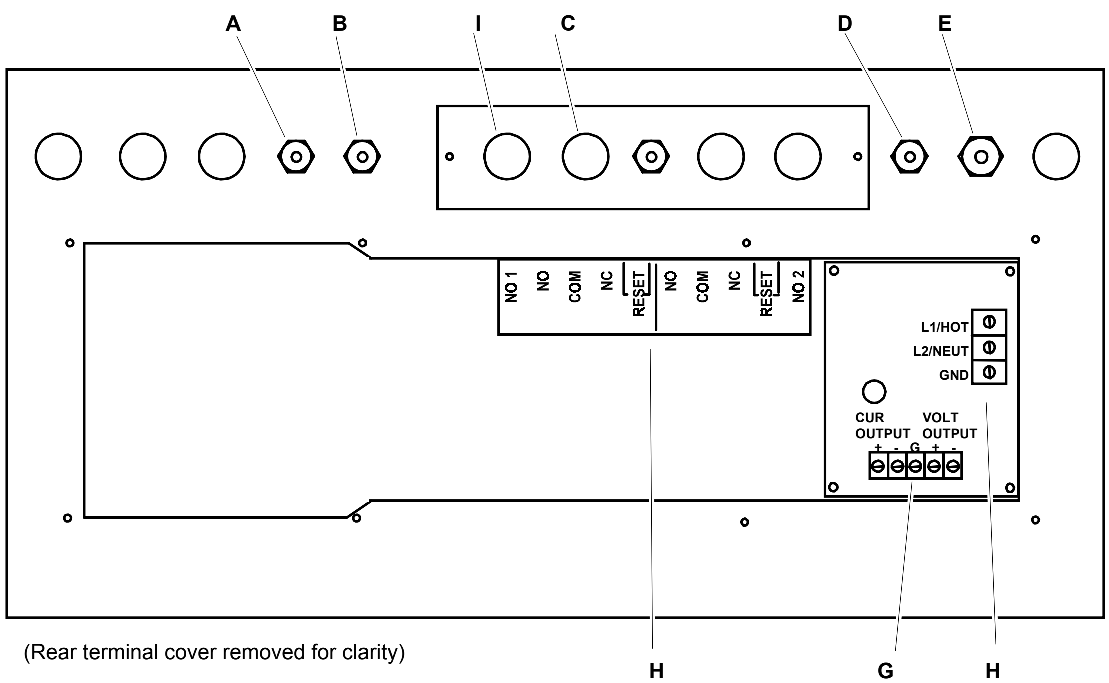
TOXIC OR CORROSIVE HAZARD

The sample containment system must be carefully leak checked upon installation and before initial start-up, during routine maintenance and any time the integrity of the sample containment system is broken, to ensure the system is in leak proof condition.

Internal leaks resulting from failure to observe these precautions could result in personal injury or property damage.

For proper operation and safety, system leakage must be corrected, particularly before introduction of toxic or corrosive samples and/or application of electrical power.

To check system for leaks, liberally cover all fittings, seals, and other possible sources of leakage with suitable leak test liquid such as SNOOP (P/N 837801). Check for leak indicative bubbling or foaming. Leaks that are inaccessible to SNOOP application could evade detection by this method.



(Rear terminal cover removed for clarity)

A. Sample outlet. 1/4” O.D. tube fitting.
B. Sample Inlet. 1/4” O.D. tube fitting.
C. 5/8” diameter hole for optional Dual Alarm Cable. Cable supplied by customer, minimum 24 AWG.
D. 5/8” diameter hole fitted with liquid-tight gland for Recorder Output Cable. Cable supplied by customer, conductor, minimum 24 AWG.
E. 13/16” diameter hole for Power Cable. Cable supplied by customer, 3 conductor, minimum 18 AWG.
F. TB1: Customer hook-up for Power.
G. TB2: Customer hook-up for Recorder Output.
H. Optional Dual Alarm connections.
I. Connections for Optional Remote Range Change.

Figure 2-2. Model 755R Rear Panel

2-5 ELECTRICAL CONNECTIONS

> **WARNING**
>
> **ELECTRICAL SHOCK HAZARD**
>
> **For safety and proper performance, this instrument must be connected to a properly grounded three-wire source of supply.**

Cable connections for AC power, recorder output, and alarm output are shown in Installation Drawing, 654015, and are explained in the following sections.

a. Line Power Connection

The analyzer is supplied, as ordered, for operation on 115 VAC or 230 VAC, 50/60 Hz. Ensure that the power source conforms to the requirements of the individual instrument, as noted on the name-rating plate.

Electrical power is supplied to the analyzer via a customer-supplied three-conductor cable, type SJT, minimum wire size 18 AWG. Route power cable through conduit and into appropriate opening in the instrument case. Connect power leads to HOT, NEUT, and GND terminals on the I/O board. Connect analyzer to power source via an external fuse or breaker, in accordance with local codes. Do not draw power for associated equipment from the analyzer power cable (Refer to Figure 2-3 below).

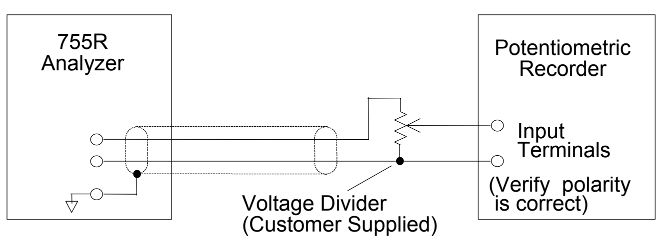
If the analyzer is mounted in a protected rack or cabinet or on a bench, an accessory kit (P/N 654008) is available which provides a 10-foot North American power cord set and a liquid-tight feed through gland for the power cable hole. The kit also contains four enclosure support feet for bench top use.

b. Recorder Output Selection and Cable Connections

If a recorder, controller, or other output device is used, connect it to the analyzer via a number 22 or number 24 AWG two-conductor shielded cable. Route the cable into the case through the liquid-tight feed through gland in the Recorder Output opening (See Installation Drawing, 654015). Connect the shield only at the recorder end or the analyzer end, not to both at the same time because a ground loop may occur.

NOTE:

Route recorder cable through a separate cable gland (P/N 899329) or conduit not with power cable or alarm output cable. Cable connections and output selection for potentiometric and current-actuated devices are explained below.



Position of Recorder Output Selector Plug	Minimum Permissible Resistance for R1 + R2 (ohms)
10 mV	1K
100 mV	10K
1 V	100K
5 V	2K

Figure 2-3. Connections for Potentiometric Recorder with Non-Standard Span

c. Potentiometric Output

1. Insert RECORDER OUTPUT Selector Plug (See Figure 3-1) in position appropriate to the desired output: 10 mV, 100 mV, 1V or 5V.

2. Connect leads of shielded recorder cable to “REC OUT +” and “-” terminals on the I/O board.

3. Connect the output cable to the appropriate terminals of the recorder or other potentiometric device:

   a. For device with span of 0 to 10 mV, 0 to 100 mV, 0 to 1V, or 0 to 5V, connect cable directly to input terminals of the device, ensuring correct polarity and range selection.

   b. For a device with intermediate span (i.e., between the specified values), connect the cable to the device via a suitable external voltage divider (See Figure 2-3, page 2-6).

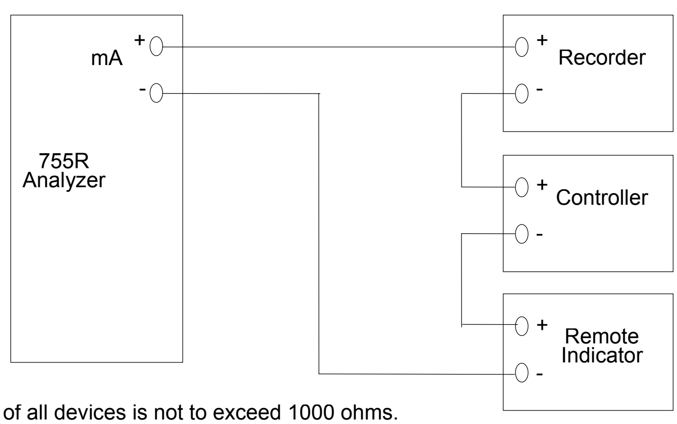
d. Isolated Current Output (Optional)

1. Verify that the optional current output board appropriate to desired output is properly in place in its connector. See Figure 3-1, page 3-3. If originally ordered with the analyzer, the board is factory installed.

2. On I/O board, connect leads of shielded recorder cable to “CURRENT OUT+” and “-” terminals.

3. Connect free end of output cable to input terminals of recorder or other current-actuated device, making sure that polarity is correct. If two or more current-actuated devices are to be used, they must be connected in series (See Figure 2-4 below). Do not exceed the maximum load resistance of 1000 ohms.

Current and voltage outputs may be utilized simultaneously if desired.



Note: Total series resistance of all devices is not to exceed 1000 ohms.

Figure 2-4. Model 755R Connected to Drive Several Current-Actuated Output Devices

e. Output Connections and Initial Setup for Dual Alarm Option

If so ordered, the analyzer is factory equipped with alarm output. Alternatively, the alarm feature is obtainable by subsequent installation of the 654019 Alarm Kit.

The alarm output provides two sets of relay contacts for actuation of alarm and/or process-control functions. Leads from the customer-supplied external alarm system connect to terminals on the 654019 Alarm Assembly (See Figure 2-5 below and Interconnect Drawing 654014).

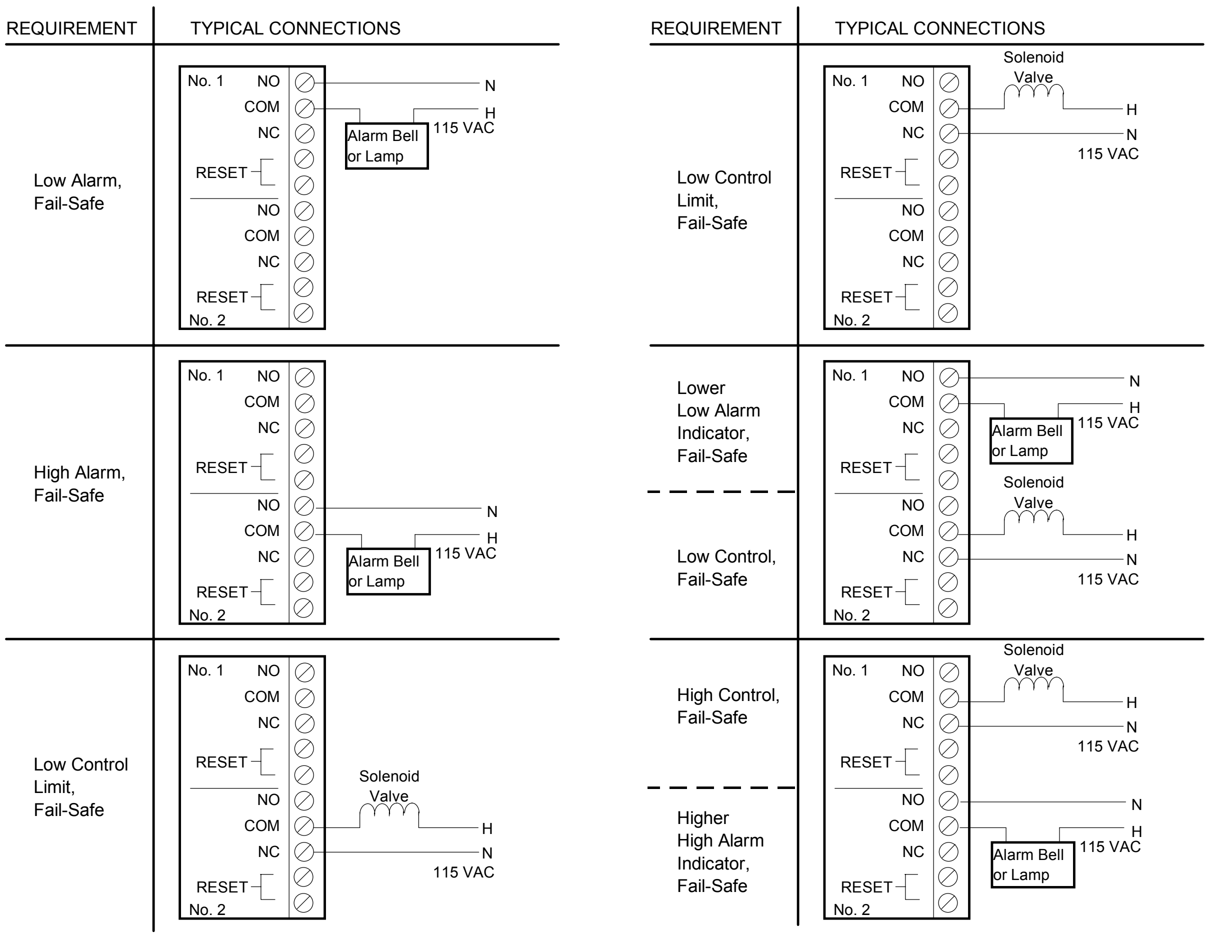


Figure 2-5. Relay Terminal Connections for Typical Fail-Safe Applications

Note the following recommendations:

- A fuse should be inserted into the line between the customer-supplied power supply and the alarm relay terminals on the Alarm Relay Assembly.
- If the alarm contacts are connected to any device that produces radio frequency interference (RFI), it should be arc suppressed. The 858728 Arc Suppressor is recommended.
- If at all possible, the analyzer should operate on a different AC power source, to avoid RFI.

Alarm 1 and Alarm 2 output through the 654019 Alarm Relay Assembly is provided by two identical single-pole, double-throw relays. These relay contacts are rated at the following values:

5 amperes	240 VAC resistive
1 ampere	240 VAC inductive
5 amperes	120 VAC resistive
3 amperes	120 VAC inductive
5 amperes	30 VDC resistive
3 amperes	30 VDC inductive

Removal of AC power from the analyzer (such as power failure) de-energizes both relays, placing them in alarm condition. Switching characteristics of the Alarm 1 and Alarm 2 relays are as follows:

The Alarm 1 relay coil is de-energized when the display moves downscale through the value that corresponds to setpoint minus deadband. This relay coil is energized when the display moves upscale through the value that corresponds to setpoint plus deadband.

The Alarm 2 relay coil is de-energized when the display moves upscale through the value that corresponds to the setpoint plus deadband. This relay coil is energized when the display moves downscale through the value that corresponds to setpoint minus deadband.

Both the ALARM 1 and ALARM 2 functions generally incorporate automatic rest. When the display goes beyond the preselected limits, the corresponding relay is de-energized. When the display returns within the acceptable range, the relay is turned on.

The ALARM 1 and/or ALARM 2 alarm functions may be converted to manual reset. The conversion requires the substitution of an external pushbutton or other momentary contact switch for the jumper that connects the RESET terminals on the Alarm Relay Assembly. If the corresponding relay is now de-energized (i.e., in alarm condition), the relay remains de-energized until the operator momentarily closes the switch.

By appropriate connection to the double-throw relay contacts, it is possible to obtain either a contact closure or a contact opening for an energized relay. Also, either a contact closure or a contact opening may be obtained for a de-energized relay. It is important, for fail-safe applications, that the user understands what circuit conditions are desired in event of power failure and the resultant relay de-energization. Relay contacts should then be connected accordingly (See Figure 2-5, page 2-8).

The ALARM 1 and ALARM 2 circuits have independent setpoint and deadband adjustments (See Figure 3-1, page 3-3). Initially, the ALARM 1 and ALARM 2 Setpoint Adjustments must be calibrated by means of the ALARM 1 and ALARM 2 Calibration Adjustments by the following procedure:

1. Set RANGE Select in a position appropriate to the span standard gas.

2. Inject span standard gas through analyzer at 50 to 500 cc/min.

3. Verify that ALARM 1 and ALARM 2 Deadband Adjustments (See Figure 3-1, page 3-3) are set for minimum value (turned fully counterclockwise). These potentiometers should be factory-set for minimum deadband. Both potentiometers MUST REMAIN at this setting throughout calibration of the alarm setpoint adjustments.

4. Adjust ALARM 1 control function as follows:

   a. With ALARM 1 Setpoint Adjustment at 100% (i.e., position 10 on dial), adjust front panel SPAN Control so that the display or recorder reads exactly fullscale.

   b. Set ALARM 1 Calibrate Adjustment (R63) to its clockwise limit.

Carefully rotate R63 counterclockwise the minimum amount required to obtain energization of ALARM 1 Relay K1 (See Figure 2-6 below and Figure 3-1, page 3-3). Energization may be verified by connecting an ohmmeter to relay terminals on 654019 Alarm Relay Assembly.

c. To verify correct adjustment of R63, adjust front panel SPAN Control so that the display or recorder reads 99% of fullscale. Relay K1 should now be DE-ENERGIZED.

5. Adjust ALARM 2 control function as follows:

   a. With ALARM 2 Setpoint Adjustment at 100% (i.e., Position 10 on the dial), adjust front panel SPAN Control so that

   b. the display or recorder reads exactly fullscale.

   c. Set ALARM 2 Calibrate Adjustment (R67) to its clockwise limit. Carefully rotate R67 counterclockwise the minimum amount required to obtain energization of ALARM 2 Relay K2 (See Figure 2-5, page 2-8).

   d. To verify correct adjustment of R67, adjust front panel SPAN Control so that the display or recorder reads 99% of fullscale. Relay K2 should now be DE-ENERGIZED.

The ALARM 1 and ALARM 2 Setpoint Adjustments are now properly calibrated and may be used to select the desired alarm setpoints, as described in Section 3-6 (page 3-7).

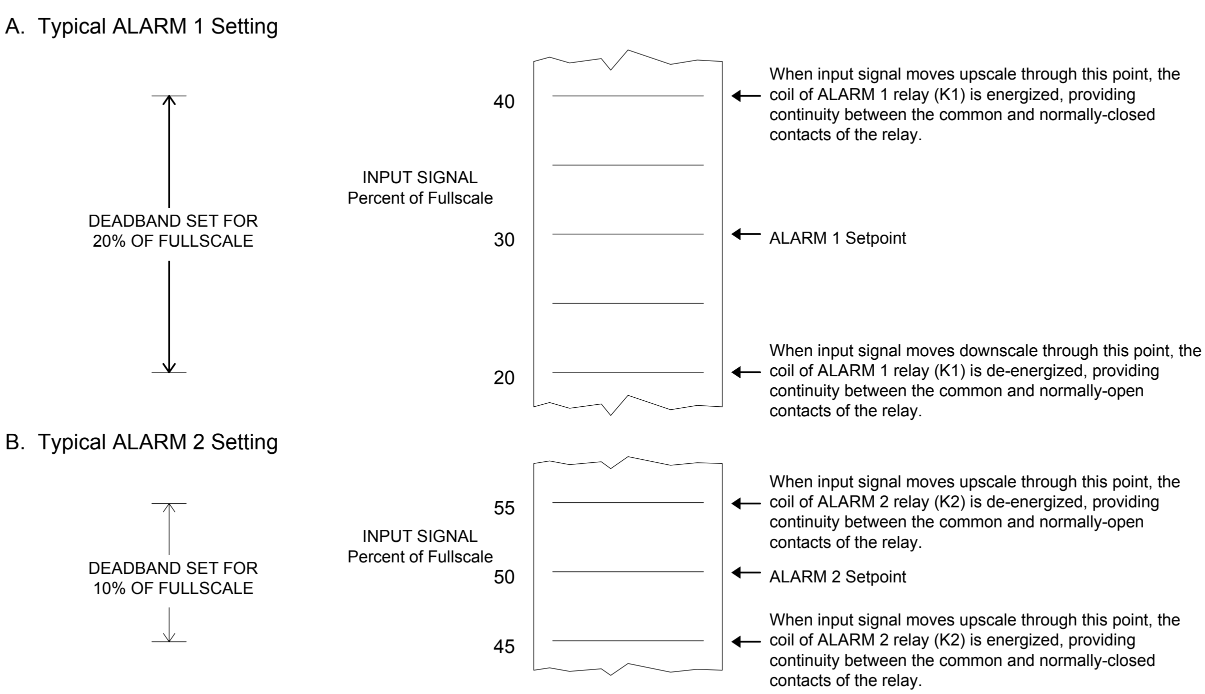
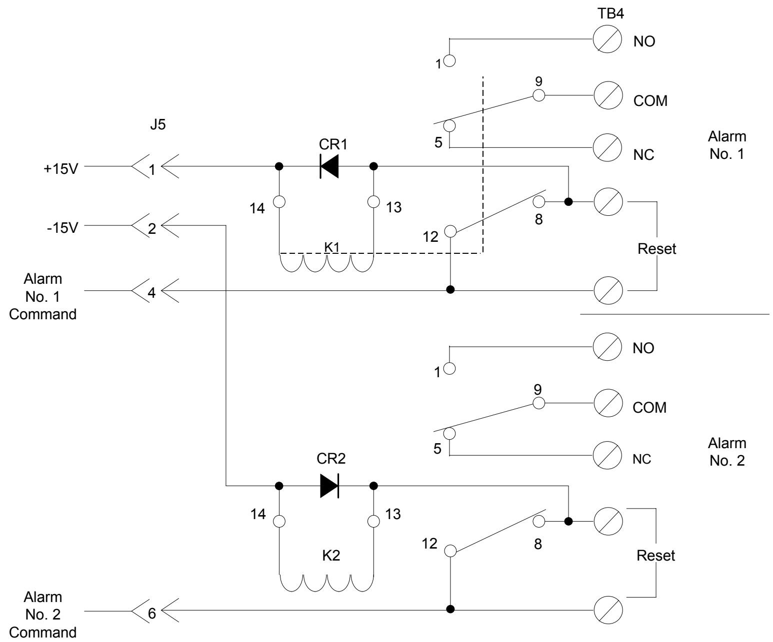


Figure 2-6. Typical Alarm Settings



2. CR! AND CR2 ARE ANY 600V, 1 AMP DIODE.
1. RELAYS SHOWN IN ENERGIZED POSITION.
NOTES:

Figure 2-7. Alarm Relay Assembly Schematic Diagram

2-6 REMOTE RANGE CHANGE OPTION

The power supply circuitry on the Remote Range Board 646004 must be jumpered for the correct line voltage, either 115 VAC or 230 VAC. See Drawings # 656081 (Table 2) and 646090 for correct jumper locations.

On the Remote Range Board, an additional option exists: for using either the on-board 12 V to drive the range select relays or an external 12 V supply.

To use an external supply:

1. Remove the E to F jumper (DWG 646090).

2. Apply the external 12 V to J3-5.

3. Program the remote controller to pull the range bits, J3-1 through J3-4, low. (See Table 2-1 below.)

To use the internal 12 V supply:

1. Verify the E to F jumper is in place.

2. Connect the controller's common to J3-6 to reference the instrument's common to the controller's common.

NOTE

DO NOT connect anything to J3-5.

3. Connect J3-1 to J3-4, as shown in the truth table below, to switch ranges.

Remember that you are dealing with inverse logic and not normal binary addresses. Also, this process switches the recorder output only, and does not affect the front panel display.

	J3-4	J3-3	J3-2	J3-1	Hex
Range 1	1	1	1	0	E
Range 2	1	1	0	1	D
Range 3	1	0	1	1	B
Range 4	0	1	1	1	7

Note: 1 = 12 V, 0 << 1 V.

Table 2-1. Remote Range Switching Truth Table

SECTION 3
OPERATION

3-1 OVERVIEW

Preparatory to operation, a familiarization with Figure 3-1 (page 3-3) is recommended. This figure gives locations and summarized descriptions of operating adjustments of the Model 755R Oxygen Analyzer.

3-2 OPERATING RANGE SELECTION

The Model 755R is designed to operate on a single, field-selectable range. A new range may be selected any time the analyzer application changes or any time calibration may require a range change.

To select the operating range, reposition the jumper shown in Figure 3-1 (page 3-3) to the desired location. Each position is labeled as to its fullscale range. Only the analog output (voltage and optional current) is affected by range selection. The digital display always reads 100% oxygen.

3-3 STARTUP PROCEDURE

Inject a suitable on-scale gas (not actual sample) through the analyzer. Turn power ON. If digital display gives overrange indication, the probable cause is the suspension in the detector is hung up. To correct this condition, turn power OFF, tap detector compartment with fingers, wait 30 seconds, turn power ON.

When on-scale reading is obtained, allow analyzer to warm-up for a minimum of one hour with gas flowing. This warm-up is necessary because a reliable calibration is obtainable only after the analyzer reaches temperature stability. Moreover, the resultant elevated temperature will ensure against condensation within, and possible damage to the detector assembly. After warm-up, the digital display or recorder should give stable, drift-free readout. If so, proceed to Section 3-4 below. Otherwise, refer to Section 6, Maintenance and Service.

3-4 CALIBRATION

Calibration consists of establishing a zero calibration point and a span calibration point (see Table 3-1, page 3-4). Zero and span calibration should be performed on the range that will be used during sample analysis. In some applications, however, it may be desirable to perform span calibration on a range of higher sensitivity (i.e., more narrow span) and then move the jumper to the desired operating range. For example, if the operating range is to be 0 to 50% oxygen, span calibration may be performed on the 0 to 25% range to permit use of air as the span standard gas.

a. Calibration with Zero and Span Standard Gases

NOTE:

The same flow rate must be maintained for zero, span, and sample to avoid measure error. The exhaust is vented to the atmosphere to avoid back pressure. The following procedure is based on the standards in Table 3-2 (page 3-6). Performance specifications are based on recorder output.

Set Zero Calibration Point

Inject nitrogen zero standard gas through analyzer at suitable flow rate, preferably 250 cc/min. Allow gas to purge analyzer for a minimum of three minutes.

Adjust ZERO control so that the reading on the digital display or recorder is zero

Set Span Calibration Point

Inject span standard gas (see Table 3-1, page 3-4) through the analyzer at the same flow rate as was used for zero standard gas. Allow gas to purge analyzer for a minimum of three minutes.

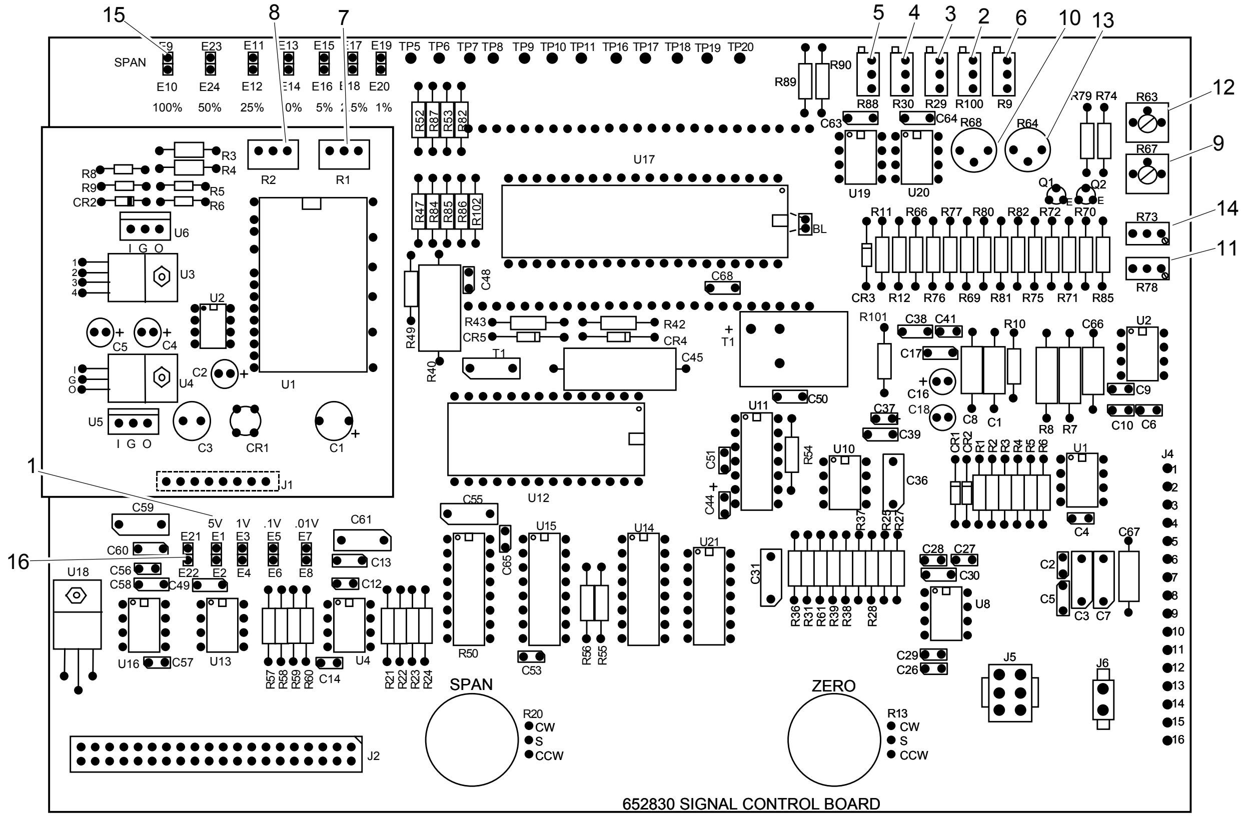
Adjust SPAN control so that reading on display or recorder is appropriate to the span standard gas.

3-5 COMPENSATION FOR COMPOSITION OF BACKGROUND GAS

Any gas having a composition other than 100% oxygen contains background gas. The background gas comprises all non-oxygen constituents. Although instrument response to most gases other than oxygen is comparatively slight, it is not in all cases negligible. The contribution of these components to instrument response is a function of the span and range used, and can be computed for each individual case.

If the zero and span standard gases contain the same background gas as the sample, the routine standardization procedure automatically compensates for the background components. Therefore, the zero and span standard gases would introduce no error.

If the background gas in the sample is different from that in the zero and/or span standard gas(es), background effects must be taken into consideration to ensure correct readout. During adjustment of the front panel ZERO and SPAN controls (see Figure 1-1, page 1-1), the instrument is not set to indicate the true oxygen content of the zero and span standard gases. It is set to indicate a slightly different value, relative to background gas, calculated to provide correct readout during subsequent analysis of the sample gas.



1. RECORDER OUTPUT selector plug	Provides selectable output of 10 mV, 100 mV, 1 V or 5 V for a voltage recorder.
2. DIGITAL READOUT (R100)	Calibration of digital readout.
3. AMPLIFIER U8 ZERO (R29)	Initial factory zeroing of amplifier U8.
4. RESPONSE TIME (R30)	Adjustment of electronic response time.
5. FULLSCALE OUTPUT (R88)	Setting fullscale for 1 V, 0.1 V and 10 mV outputs.
6. DETECTOR COARSE ZERO (R9)	Coarse adjustment of detector zero by shifting the position of the detector within the magnetic field. It is adjusted during factory checkout, and does not require readjustment except if detector is replaced.
7. CURRENT OUTPUT ZERO (R1)	Located on Current Output Board, adjustment for zero-level current output, i.e., 4mA or 0mA
8. CURRENT OUTPUT SPAN (R2)	Located on Current Output Board, adjustment for fullscale current output: 20mA
9. ALARM 2 CALIBRATION (R67)	Initial calibration of ALARM 2 circuit.
10. ALARM 2 SETPOINT (R68)	Continuously variable adjustment of setpoint for ALARM 2 circuit, for actuation of external, customer supplied control device(s). Adjustment range is 0 to 100% of fullscale span.
11. ALARM 2 DEADBAND (R78)	Adjustment of ALARM 2 deadband circuit from 1% to 20% of fullscale. Deadband is essentially symmetrical with respect to setpoint.
12. ALARM 1 CALIBRATION (R63)	Initial calibration of ALARM 1 circuit.
13. ALARM 1 SETPOINT (R64)	Continuously variable adjustment of setpoint for ALARM 1 circuit, for actuation of external, customer supplied control device(s). Adjustment range is 0 to 100% of fullscale span.
14. ALARM 1 DEADBAND (R73)	Adjustment of ALARM 1 deadband circuit from 1% to 20% of fullscale. Deadband is essentially symmetrical with respect to setpoint.
15. OUTPUT RANGE selector plug	Selectable fullscale output range.
16. DETECTOR ISOLATION plug	For servicing and testing of the Control Board.
DIGITAL DISPLAY	Display (viewed on front panel) indicates oxygen content of sample.
ZERO control (R13)	Accessible on front panel, use to establish zero-calibration point.
SPAN control (R20)	Accessible on front panel, use to establish span calibration point.

Figure 3-1. Control Board - Adjustment Locations

RANGE % OXYGEN	RECOMMENDED ZERO STANDARD GAS	RECOMMENDED SPAN STANDARD GAS
0 to 1	Nitrogen	0.9% O2, balance N2
0 to 2.5	Nitrogen	2.3% O2, balance N2
0 to 5	Nitrogen	4.5% O2, balance N2
0 to 10	Nitrogen	9% O2, balance N2
0 to 25	Nitrogen	Air (20.93% O2)
0 to 50	Nitrogen	45% O2, balance N2
0 to 100	Nitrogen	100% O2

Table 3-1. Calibration Range for Various Zero-Based Operating Ranges

a. Oxygen Equivalent Value of Gases

For computation of background corrections, the analyzer response to each component of the sample must be shown. Table 3-2 (page 3-6) lists the percentage oxygen equivalent values for many common gases.

The percentage oxygen equivalent of a gas is the instrument response to the given gas compared to the response to oxygen, assuming that both gases are supplied at the same pressure .

In equation form:

%O2 Equivalent of Gas =

$$\frac{\text{Analyzer Response to Gas}}{\text{Analyzer Response to } O_2} \text{ X } 100\%$$

To select a random example from Table 3-2, if analyzer response to oxygen is +100%, the response to xenon would be -1.34%.

The oxygen equivalent of a gas mixture is the sum of the contribution of the individual gas components.

Example: Zero Based Range

At lower range limit, i.e., 0% oxygen, composition of sample is 80% CO_2, 20% N_2.

From Table 3-1 (page 3-4), the % oxygen equivalents are CO_2. -0.623 and N_2, -0.358%.

% oxygen equivalent of mixture =

0.8 x (-0.623) + 0.2 x (-0.358) = (-0.4984) + (-0.0716) = -0.570% Oxygen

b. Computing Adjusted Settings for Zero and Span Controls

During instrument calibration, adjusted values may be required in setting the ZERO and SPAN controls to correct for the magnetic susceptibility of the background gas.

The quantities are defined as follows:

BGGst = Oxygen equivalent of background gas in standard gas (see Table 3-2, page 3-6)

BGGs = Oxygen equivalent of background gas sample (see Table 3-2, page 3-6)

OP = operating pressure. Unless special pressure corrections are to be made, the zero standard, span standard and sample gases must all be admitted at the same pressure.

Use the following equation to compute the adjusted settings for the ZERO and SPAN controls:

Adjusted % O_2 for standard gas =

$$\frac{(A)[100 + (B-C)] - 100 [B-C]}{100}$$

Where:

A = true % O_2 of standard gas

B = BGGs

C = BGGst

Example:

Background gas in sample is CO_2, oxygen equivalent = -0.623%
Zero gas is 100% N_2
Span standard gas is air: 21% O_2, 79% N_2
Background gas in zero and span standard gases is N_2, oxygen equivalent = -0.358%
With N_2 zero standard gas flowing, ZERO control is adjusted so digital display reads:

$$\frac{0[100+(-0.623-(-0.358))] - 100[-0.623-(-0.358)]}{100} = 0.265\% \ O_2$$

With air flowing, SPAN control is adjusted so the digital display reads:

$$\frac{21[100 - 0.265) - 100 (-0.265)}{100} = 21.209\% \ O_2 \cong 21.21$$

In two limiting cases, the general equation is reduced to simpler forms.

1. If the span standard gas is 100% oxygen, the adjusted oxygen value for setting the SPAN control is the same as the true value (i.e., 100% oxygen).

2. If the zero standard is an oxygen-free zero gas, the adjusted value for setting the ZERO control = BGGst - BGGs. (If the oxygen-free zero gas is more diamagnetic than the background gas in the sample, this difference is negative. The negative value may be set on the digital display or the recorder if provided with below-zero capability.)

GAS	EQUIV. % AS
Acetylene, C_2H_2	-0.612
Allene, C_3H_4	-0.744
Ammonia, NH_3	-0.479
Argon, A	-0.569
Bromine, Br_2	-1.83
1,2-Butadiene C_4H_6	-1.047
1,3-Butadiene C_4H_6	-1.944
n-Butane, C_4H_{10}	-1.481
iso-Butane, C_4H_{10}	-1.485
Butene-1, C_4H_8	-1.205
cis Butene-2, C_4H_8	-1.252
iso-Butene, C_4H_8	-1.201
trans butene-2, C_4H_8	-1.274
Carbon Dioxide CO_2	-0.623
Carbon Monoxide, CO	-0.354
Ethane, C_2H_6	-0.789
Ethylene, C_2H_4	-0.553
Helium, H_e	-0.059
n-Heptane, C_7H_{16}	-2.508
n-Hexane, C_6H_{12}	-2.175
cyclo-Hexane, C_6H_{12}	-1.915
Hydrogen, H_2	-0.117
Hydrogen Bromide, Hbr	-0.968
Hydrogen Chloride, HC1	-0.651
Hydrogen Fluoride, HF	-0.253
Hydrogen Iodide, HI	-1.403
Hydrogen Sulphide, C_2S	-0.751
Kryton, Kr	-0.853
Methane, CH_4	-0.512
Neon, Ne	-0.205
Nitric Oxide, NO	+44.2
Nitrogen, N_2	-0.358
Nitrogen Dioxide, NO_2	+28.7
n-Octane, C_8H_{18}	-2.840
Oxygen, O_2	+100.0
n-Pentane, C_5H_{12}	-1.810
iso-Pentane, C_5H_{12}	-1.853
neo-Pentane, C_5H_{12}	-1.853
Propane, C_3H_8	-1.135
Propylene, C_3H_6	-0.903
Water, H_2O	-0.381
Xenon, Xe	-1.340

Table 3-2. Oxygen Equivalent of Common Gases

3-6 SELECTION OF SETPOINTS AND DEADBAND ON ALARM OPTION

The ALARM 1 and ALARM 2 setpoint adjustments (see Figure 3-1, page 3-3) are adjustable for any desired value from 1% to 100% of the fullscale analyzer span. The adjustment screws are graduated from 0 to 10.

Required dial settings for both setpoint adjustments may be determined from either Figure 3-2 or the appropriate equation that follows:

- Zero-based operating range
- Required control setting =

$$\frac{\text{(desired alarm setpoint)(10)}}{\text{fullscale span}}$$

Figure 3-2 example:

Operating range, 0 to 5% oxygen

Desired ALARM 1 setpoint = 4% oxygen

Turn potentiometer R64 to 8

Desired ALARM 2 setpoint = 3% oxygen

Turn potentiometer R68 to 6

The desired deadband may be selected via the appropriate trimming potentiometer, R73, for ALARM 1 deadband adjustment and R78 for ALARM 2 deadband adjustment. For any setpoint, deadband is adjustable from 1% of fullscale (counterclockwise limit) to 20% of fullscale (clockwise limit). Deadband is essentially symmetrical with respect to setpoint.

3-7 CURRENT OUTPUT BOARD (OPTION)

The Current Output is set at the factor for 4 to 20 mA. If a 0 to 20 mA output is required, readjust both the zero and span potentiometers (R1 and R2) on the Current Output Board.

RANGE % OXYGEN	PERCENTAGE OXYGEN READOUT versus ALARM SETPOINT DIAL READING
0 to 1	Percentage Oxygen Readout 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 0 1 2 3 4 5 6 7 8 9 10 Setpoint Dial Reading
0 to 2.5	Percentage Oxygen Readout 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 0 1 2 3 4 5 6 7 8 9 10 Setpoint Dial Reading
0 to 5	Percentage Oxygen Readout 0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 0 1 2 3 4 5 6 7 8 9 10 Setpoint Dial Reading
0 to 10	Percentage Oxygen Readout 0 1 2 3 4 5 6 7 8 9 10 0 1 2 3 4 5 6 7 8 9 10 Setpoint Dial Reading
0 to 25	Percentage Oxygen Readout 0 2.5 5 7.5 10 12.5 15 17.5 20 22.5 25 0 1 2 3 4 5 6 7 8 9 10 Setpoint Dial Reading
0 to 50	Percentage Oxygen Readout 0 5 10 15 20 25 30 35 40 45 50 0 1 2 3 4 5 6 7 8 9 10 Setpoint Dial Reading
0 to 100	Percentage Oxygen Readout 0 10 20 30 40 50 60 70 80 90 100 0 1 2 3 4 5 6 7 8 9 10 Setpoint Dial Reading

Figure 3-2. Dial Settings for Alarm Setpoint Adjustments

3-8 ROUTINE OPERATION

After the calibration procedure of Section 3-4 (page 3-1), admit sample gas to the analyzer at the same pressure and the same flow rates used for the zero and span gases. The instrument will now continuously indicate the oxygen content of the sample gas.

3-9 EFFECT OF BAROMETRIC PRESSURE CHANGES ON INSTRUMENT READOUT

If the analyzer exhaust port is vented through a suitable absolute backpressure regulator, barometric pressure changes do not affect the percent oxygen readout. However, if the analyzer exhaust port is vented directly to the atmosphere, any change in barometric pressure after instrument standardization will result in a directly proportional change in the indicated percentage of oxygen. This effect may be compensated in various ways. If desired, correction may be made by the following equation:

True % Oxygen = (Pst/Pan)(Indicated % Oxygen)

Where:

Pst = Operating pressure during standardization

Pan = Operating pressure sample analysis

Example: U.S. Units

Pst = 760 mm Hg

Pan = 740 mm Hg

Indicated % O2

True % O2 = (760/740)(40%) = 41.1% O2

Example: S.I. Units

Pst = 101 kPa

Pan = 98.2 kPa

Indicated % O2 = 40%

True % O2 = (101/98.2)(40%) = 41.1% O2

3-10 CALIBRATION FREQUENCY

The appropriate calibration interval will depend on the accuracy required in the particular application, and is best determined by keeping a calibration log. If the analyzer exhaust port is vented directly to the atmosphere, the greatest source of error is normally the variation in barometric pressure. If desired, effects of barometric pressure variation can be minimized by calibrating immediately before taking readings, for example, at the beginning of each shift.

SECTION 4
THEORY

4-1 PRINCIPLES OF OPERATION

Oxygen is strongly paramagnetic while most other common gases are weakly diamagnetic. The paramagnetism of oxygen may be regarded as the capability of an oxygen molecule to become a temporary magnet when placed in a magnetic field. This is analogous to the magnetization of a piece of soft iron. Diamagnetic gases are analogous to non-magnetic substances.

With the Model 755R, the volume magnetic susceptibility of the flowing gas sample is sensed in the detector/magnet assembly. As shown in the functional diagram of Figure 5-1, a dumbbell-shaped, nitrogen-filled, hollow glass test body is suspended on a platinum/nickel alloy ribbon in a non-uniform magnetic field.

Because of the “magnetic buoyancy” effect, the spheres of the test body are subjected to displacement forces, resulting in a displacement torque that is proportional to the volume magnetic susceptibility of the gas surrounding the test body.

Measurement is accomplished by a null-balance system, where the displacement torque is opposed by an equal, but opposite, restorative torque. The restorative torque is due to electromagnetic forces on the spheres, resulting from a feedback current routed through a titanium wire conductor wound lengthwise around the dumbbell.

In effect, each sphere is wound with a one-turn circular loop. The current required to restore the test body to null position is directly proportional to the original displacement torque, and is a linear function of the volume magnetic susceptibility of the sample gas.

The restoring current is automatically maintained at the correct level by an electro-optical feedback system. A beam of light from the source lamp is reflected off the square mirror attached to the test body, and onto the dual photocell.

The output current from the dual photocell is equal to the difference between the signals developed by the two halves of the photocell. This difference, which constitutes the error signal, is applied to the input of an amplifier circuit that provides the restoring current.

When the test body is in null position, both halves of the photocell are equally illuminated, the error signal is zero, and the amplifier is unequal. This condition results in application of an error signal to the input of the amplifier circuit. The resultant amplifier output signal is routed through the current loop, thus creating the electromagnetic forces required to restore the test body to null position.

Additionally, the output from the amplifier is conditioned as required to drive the digital display, and recorder if used. The electronic circuitry involved is described briefly in Section 4-3 (page 4-4) and in greater detail in Section 5.

4-2 VARIABLES INFLUENCING PARAMAGNETIC OXYGEN MEASUREMENTS

Variables that influence paramagnetic oxygen measurements include: operating pressure (See Section 4-3a, page 4-4), sample temperature, interfering sample components, and vibration (See Section 2-1d, page 2-1).

a. Pressure Effects

Although normally calibrated for readout in percent oxygen, the Model 755R actually responds to oxygen partial pressure. The partial pressure of the oxygen component in a gas mixture is proportional to the total pressure of the mixture. Thus readout is affected by pressure variations.

For instance, assume that an instrument is calibrated for correct readout with a standard gas containing 5% oxygen, admitted at the normal sea level atmospheric pressure of 14.7 psia (101.3 kPa). If the operating pressure now drops to one-half the original value (i.e., to 7.35 psia {50.65 kPa}) and the calibration controls are left at the previously established settings, the display reading for the standard gas will drop to 2.5%.

It is therefore necessary to calibrate the instrument at the same pressure that will be used during subsequent operation, and to maintain this pressure during operation.

Typically, the sample gas is supplied to the analyzer inlet at slightly above ambient pressure, and is discharged to ambient pressure from the analyzer outlet. However, in some applications, it is necessary to insert an absolute back pressure regulator into the exhaust line to prevent the readout error that would otherwise result from fluctuations in exhaust pressure. The regulator must be mounted in a temperature-controlled housing (See Section 2-3c, page 2-3).

Operation at negative gauge pressure is not normally recommended, but is used in certain special applications (See Section 2-3d, page 2-4).

CAUTION

PRESSURE MINIMUM

Never subject the sensing unit to an absolute pressure of less than 500 mm Hg (66.7 kPa).

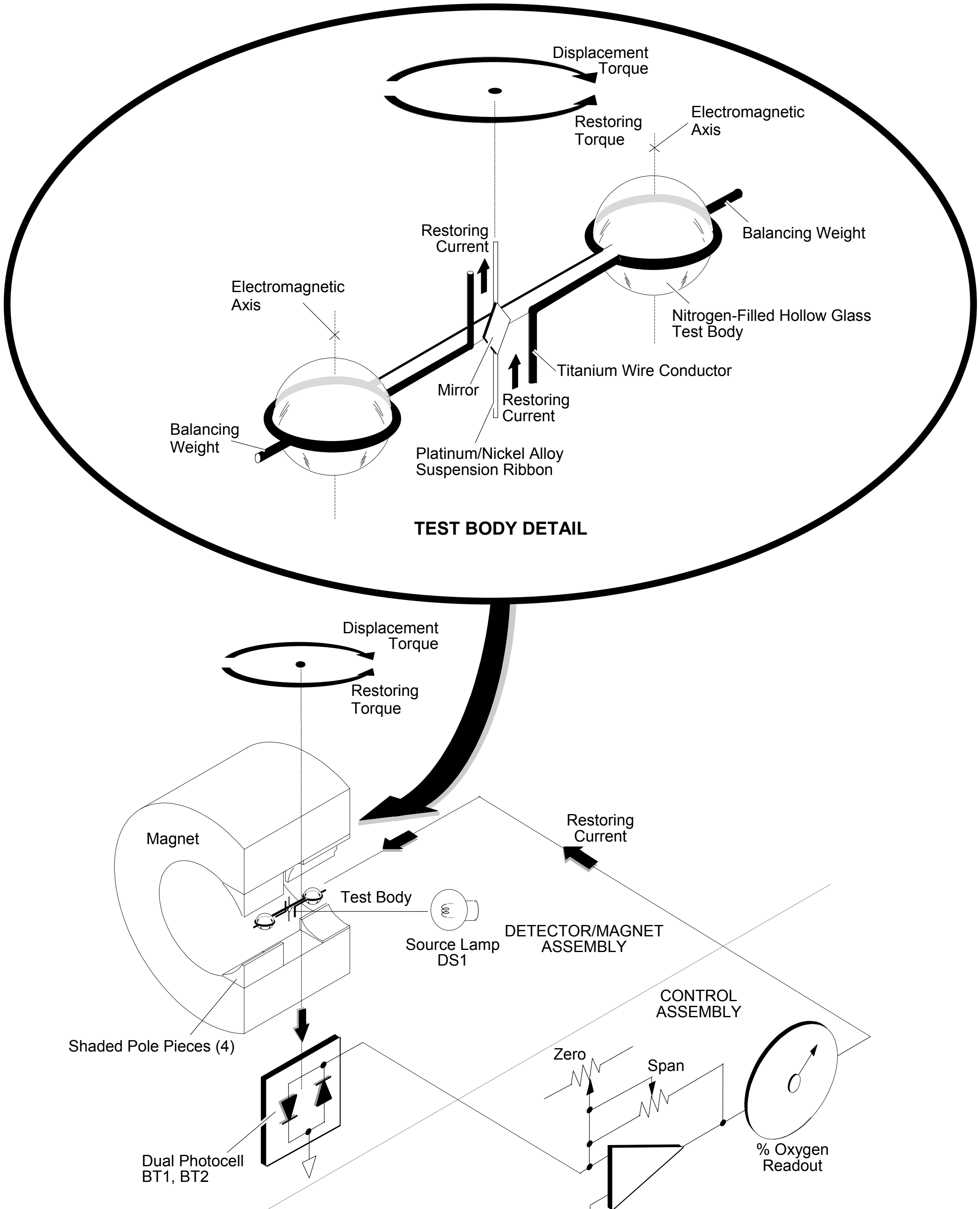


Figure 4-1. Functional Diagram of Paramagnetic Oxygen Measurement System

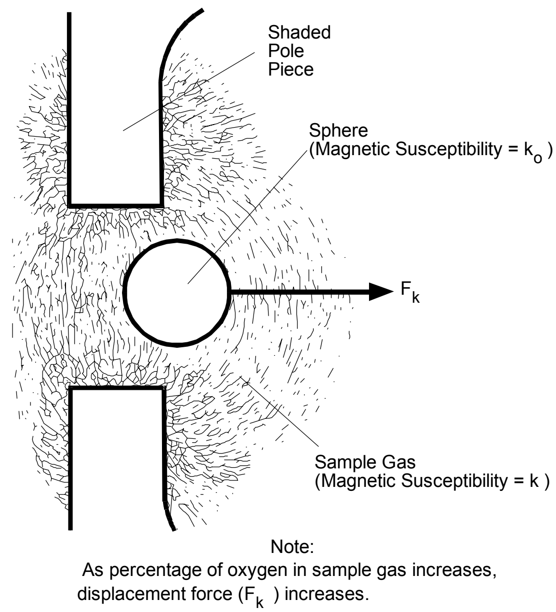


Figure 4-2. Spherical Body in Non-Uniform Magnetic Field

4-3 ELECTRONIC CIRCUITRY

Electronic circuitry is shown in the Control Board schematic diagram, Drawing 652826, and is described briefly in the following sections. For detailed circuit analysis, refer to Section 5 Circuit Analysis.

a. Detector/Magnet Assembly

A cross-sectional view of the optical bench and detector assemblies is shown in Figure 4-3B, page 4-7. Source lamp DS1, powered by a supply section within the Power Supply Board assembly (See Section 4-3c, page 4-5) directs a light beam onto the mirror attached to the test body. The mirror reflects the beam onto dual photocell BT1, BT2.

The difference between the signals developed by the two halves of the photocell constitutes the error signal supplied to the input of amplifier U1 on the Control Board assembly. Amplifier U1 drives U2 which, in turn, supplies the restoring current to the titanium wire loop on the test body (See Section 4-1, page 4-1).

Detector temperature is sensed by thermistor RT1, an integral part of the detector assembly (See Figure 4-3B, page 4-7). The thermistor provides the input signal to the detector temperature control section of the Power Supply Board assembly: HR1, mounted on the top of the magnet, and HR2, mounted permanently on the rear of the detector assembly.

b. Control Board and Associated Circuitry

The Control Board consists of signal conditioning and control circuitry.

This circuitry includes the following:

Input Amplifier U1

This amplifier receives the error signal from the dual photocell of the detector assembly and drives amplifier U2.

Amplifier U2 and Associated Zero Adjustment

Amplifier U2 supplies the restoring current to the titanium wire loop of the test body within the detector assembly. Front panel ZERO Control R13 applies an adjustable zero biasing signal to the input of U2 to permit establishing a zero calibration point on the display or recorder. With zero standard gas flowing through the analyzer, the ZERO control is adjusted for the appropriate reading.

Amplifier U4 and Associated Span Adjustment

Amplifier U4 and associated feed back resistors provide a signal amplification of X4. Front panel SPAN adjustment R20 modifies the value of the input resistance and hence the signal amplification factor. Adjustment range is approximately ±30%.

Amplifier U8

This unity gain amplifier provides zeroing capability and a buffered output for the anticipation circuit feeding U10.

Amplifier U10

U10 is an inverting buffer amplifier that incorporates an anticipation arrangement in its input network, thus providing slightly faster response on the readout device(s).

Potentiometer R30 provides a continuously variable adjustment of 5 to 25 seconds for the electronic anticipation time and is factory-set for 20 seconds.

Since the anticipation network attenuates the signal, a gain of 10 is provided in U10 to restore the signal to the desired full-scale range of 0 to 10 VDC.

The output signal from U10 is routed to two output circuits: a digital and an analog.

In the Digital Output Circuit, the signal from U10 passes to an integrating analog-to-digital converter. The resulting digital signal drives the liquid crystal display.

In the Analog Output Circuit, the output from U10 is provided as an input to the recorder output amplifier. This circuitry provides scale expansion, and amplification preparatory to use for potentiometric recorder, voltage-to-current conversion for current recorder, and/or alarm functions.

Potentiometric output is strap-selectable for 0 to 10 mV, 0 to 100 mV, 0 to 1 V, or 0 to 5VDC. Potentiometer R88 permits adjustment of recorder span on 0 to 1 V, 100 mV and 10 mV outputs.

c. Power Supply Board Assembly

The Power Supply Board assembly contains power supply and temperature control circuitry. The assembly is mounted within the analyzer case.

As shown in DWG 617186, the various circuits operate on main power transformer T1. During instrument assembly, the two primary windings of T1 are factory-connected for operation on either 115 VAC or 230 VAC, as noted on the name rating plate.

The same circuit board contains the following:

Source Lamp Power Supply Section

This circuit provides a regulated output of 2.20 VDC to operate incandescent source lamp DS1 within the optical bench assembly. One secondary of main power transformer T1 drives a fullwave rectifier consisting of CR7 and CR8. The output of DS1 is held constant by a voltage regulator circuit utilizing U7, Q4 and Q5.

±15 V Power Supply Section

This section provides DC voltage required for various amplifiers and other circuits.

Fullwave rectifier bridge CR5 provides both positive and negative outputs. Each is routed through an associated series type integrated circuit, voltage regulator, providing regulated outputs of +15 V and -15 V.

Detector Temperature Control Section

This section maintains the detector at a controlled temperature of 150°F (66°C). Temperature is sensed by RT1, a resistance element permanently attached to the detector assembly. The signal from the sensor is applied to amplifier AR6, which drives transistors Q2 and Q3, thus controlling application of DC power from full wave rectifier bridge CR6 to two heaters within the detector/magnet assembly: HR1, mounted on the top of the magnet and HR2, permanently mounted on the rear of the detector assembly.

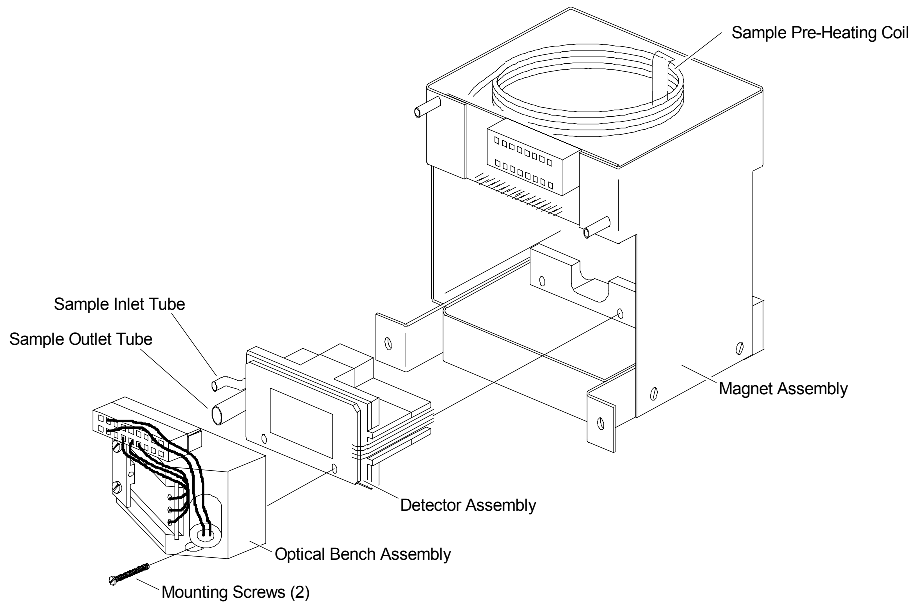
Detector Compartment Temperature Control Section

This section maintains the interior of the detector compartment at a controlled temperature of 140°F (60°C). Temperature is sensed by a thermistor located in the detector compartment and plugged into the Control Board assembly.

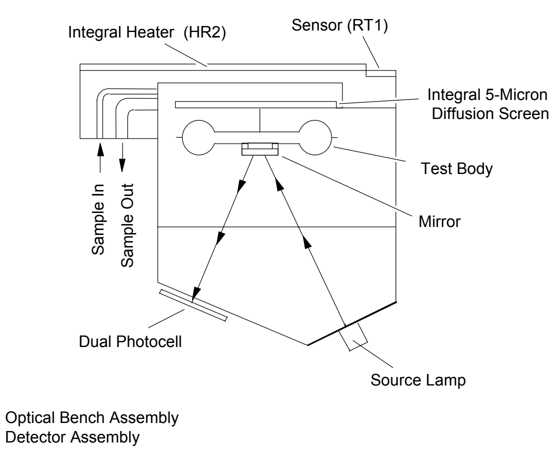
The circuit provides an on-off control of heater element HR3 via TRIAC element Q7. Heater HR3 is a part of the heater/fan assembly.

a. Isolated Current Output Board (Optional)

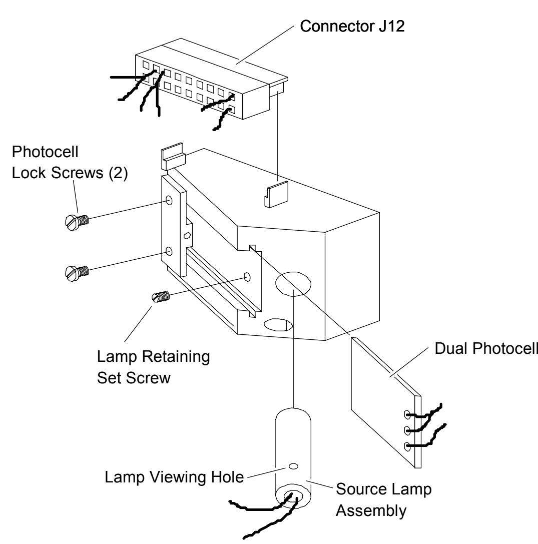
An isolated current output is obtainable by insertion of an optional plug-in circuit board into receptacle J1 on the Control Board (see Figure 3-1, page 3-3). The current outputs available by this board are 0 to 20 mA or 4 to 20 mA.



A. Exploded View of Detector/Magnet Assembly



B. Sectional Top View of Optical Bench and Detector Assemblies



C. Exploded View of Optical Bench Assembly

Figure 4-3. Detector/Magnet Assembly

SECTION 5
CIRCUIT ANALYSIS

5-1 CIRCUIT OPERATION

The electronic circuitry of the Model 755R Oxygen Analyzer consists of the following:

- A detector compartment heater circuit.
- A detector heater circuit.
- A ±15 VDC power supply.
- A voltage regulating circuit for a stable light source.
- A detector circuit with a first-stage amplifier to provide a feedback current for mechanical feedback to the detector and a scaling amplifier circuit to give an output change of 0 to +2.5 V for a 0 to 100% change of the operating span.
- A digital output circuit for the digital read-out.
- An analog output circuit for recorder, optional alarms and current output.

5-2 ±15 VDC POWER SUPPLY

Refer to Drawing 617186. The components of the ±VDC power supply circuit are located in the lower left-hand corner of the Power Supply Board. 19 VAC should be measured with respect to ground at CR5 (WO4). +15 VDC should be measured at the C27 (+) lead and -15 VDC at the C28 (-) lead. If the specified voltage measurements are obtained, the power supply is working correctly.

5-3 CASE HEATER CONTROL CIRCUIT

The case heater control circuit utilizes four voltage-comparators (LM339 quad comparator). An understanding of how one of these comparators functions is necessary before any circuit analysis can be attempted.

In Figure 5-1 (page 5-2), comparators 1 and 2 are depicted having a comparator within an overall comparator symbol. Also within this symbol, the base of the NPN transistor is connected to the output of the comparator. A -15 VDC is supplied to the emitter. The collector is illustrated as the overall output for the comparator package.

When the non-inverting terminal of comparator 2 is more positive than the inverting terminal, the transistor does not conduct and the collector of the transistor or comparator output is at whatever potential is then present on the collector.

When the non-inverting terminal of comparator 2 is less positive (more negative) than the inverting terminal, the transistor conducts and the output of the comparator is -15 V. This value is the output of the OR circuit.

Comparator 2 is biased at 0 volts on the inverting terminal. Comparator 1 is biased at about 159 mV on the non-inverting terminal. Positive feedback or hysteresis is built into each comparator circuit for stability or positive action. This is achieved by the 20 M resistances, R70 and R73.

An approximate 8 V peak-to-peak AC signal is applied to comparators 1 and 2. As the signal starts going positive, comparator 2 transistor ceases conducting and comparator 1 transistor is off.

When the signal exceeds the +159 mV on the non-inverting terminal, it turns on comparator 1 and the output is -15 V. Comparator 1 stays on until the signal drops below +159 mV, at which time the output will be the value of the OR bus.

As the AC signal goes negative with respect to ground, the transistor of comparator 2 conducts and the output is again -15 V. The output remains at -15 VDC until the incoming signal crosses zero value and the positive signal causes the comparator 2 transistor to cease to conduct.

Summing the effects of the two comparators in the OR circuit results in no output from the comparators for about 4° of the sine wave, 2° after the signal goes positive (0 to 2°) and 2° before the positive signal reaches 180° (178° to 180°).

During the period that neither comparator is conducting, the value on the OR bus is the potential from the temperature-sensing bridge plus the effect of the ramp generator, probably -1.88 ±0.03 V.

The on-off effect of the comparators to the OR circuit results in application of a positive-going pulse (from -15 V to -1.89 V) to the temperature bridge at the rate of 120 pulses per second.

Capacitor C36 is added to the input circuit to delay the incoming AC signal so that the pulses will occur at or just after the line frequency crossover point.

Circuits for a ramp generator and a temperature-sensing bridge are part of the case heater control circuit (See Figure 5-2, page 5-3 and Figure 5-3, page 5-3).

On initial application of power to comparator of Figure 5-2 (page 5-3), no potential exists on the inverting terminal because no charge exists on capacitor, C37. If the transistor of comparator 3 does not conduct, +15V is at the output terminal. With +15V at the output, the potential on the non-inverting terminals will be about ±2.3 V because of the resistance divider, R75, R76.

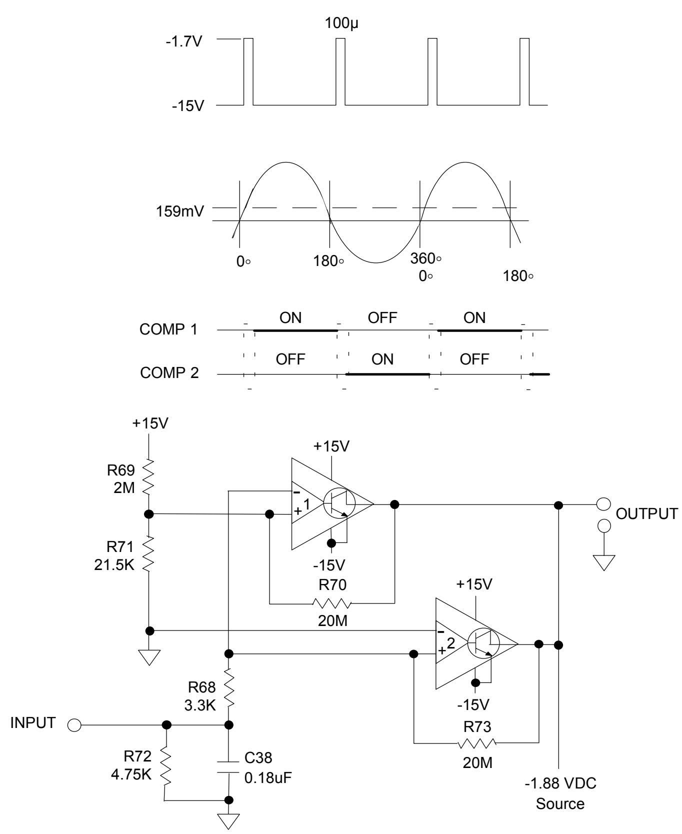


Figure 5-1. Two-Comparator OR Circuit

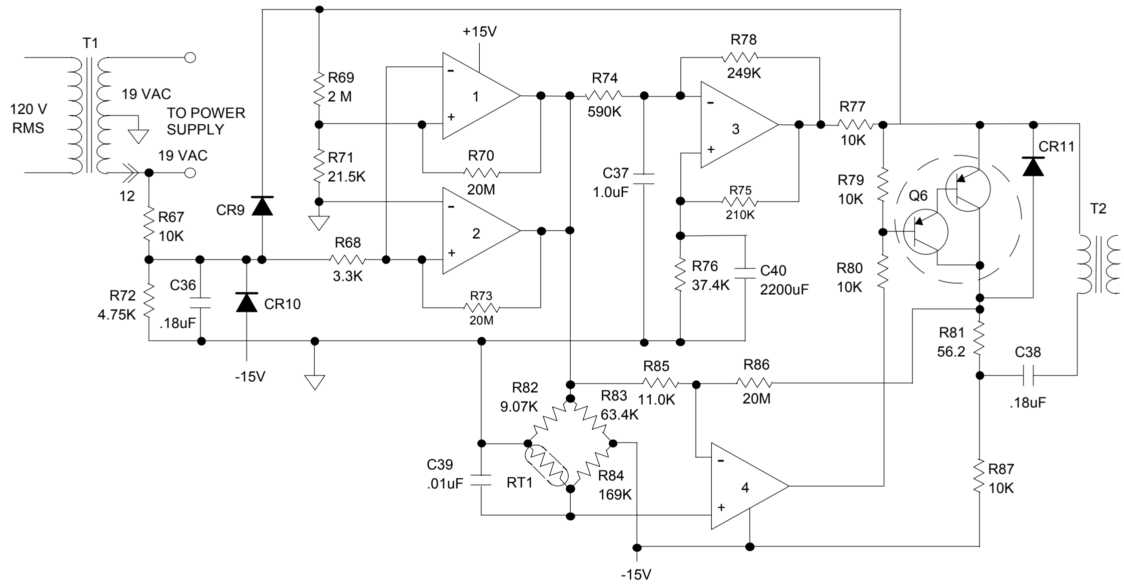


Figure 5-2. Case Heater Control Circuit

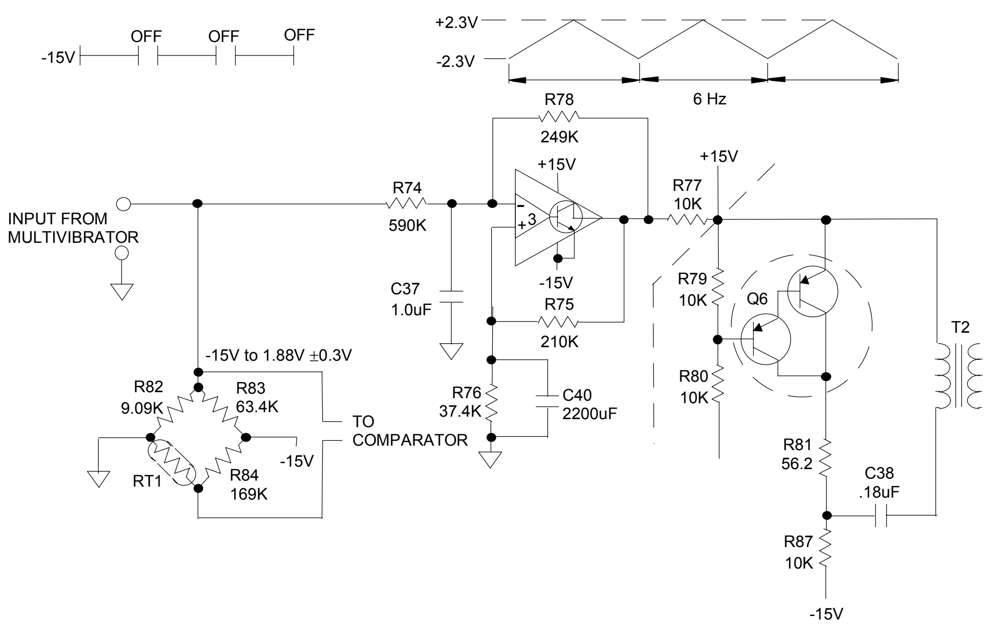


Figure 5-3. Ramp Generator Circuit

Capacitor C37 will now start to charge positively through R78. When the positive potential across C37 and at the inverting terminal of comparator 3 exceeds the potential on the non-inverting terminals, the transistor conducts. The output is -15 V. A full 30 V drop appears across R77.

The potential on the non-inverting terminal will now be about -2.3 V. C37 will not discharge through R78 until its potential exceeds that on the non-inverting terminal. At that time, comparator 3 will switch polarity and start charging C37 again. The result is that the potential across C37 will vary almost linearly with time and form a ramp signal of about 6 Hz.

As the potential across C37 increases and decreases linearly, it affects the potential at the top of the bridge circuit between R82 and R83 through R74. Because of the ramp action charging and discharging C37, the potential between R82 and R83 varies approximately from -1.85 V to -1.92 VDC.

The temperature sensing device, RT1, in the bridge circuit is a thermistor. The bridge is designed to control the temperature in the case at 135°F (57°C). When the temperature is 135°F (57°C), the resistance of the thermistor RT1 will be at its lowest and the potential at the junction of RT1 and R84 should be the same as the junction of R82 and R83. Comparator 4 (See Figure 5-4, page 5-6) does not allow pulses from the OR circuit (comparators 1 and 2) to operate Q6 or Triac Q7 in the case heater (See Figure 5-5, page 5-7).

Theoretically, at 135°F (57°C) the potential at the junction of RTR1 and R84 is -1.85VDC. This is equivalent to a resistance of 21.2 K. By substituting a decade box for the thermistor and placing 20.2 K into the bridge, the heater should be off. With 22.7 K, the heater should be full on.

Since the potential at the junction of R82 and R83 can vary between 1.85V and 1.92V according to the 6 Hz ramp, and the potential at the junction of RT1 and R84 may vary around or within these limits, depending on temperature, the error signal to comparator 4 may vary from 0mV to some absolute value. The polarity of the error signal will depend on the deviation from the desired temperature and the ramp value at the function of R82 and R83.

The input from the OR circuit comparator (See Figure 5-1, page 5-2) is either -15 VDC or the ramp effect on the bridge. When -15V, the junction of R82 and R83 is also this value. The error signal into comparator 4 is negatively large to the inverting terminal. Comparator 4 output transistor does not conduct. The base of Q6 is positive; therefore, Q6 does not conduct and a charge builds up on capacitor C38.

The input from the OR comparators 1 and 2 form multivibrator circuit, pulses 120 times a second. For about 100 microseconds the junction of R82 and R83 is some value between -1.85 V and -1.92 V, depending on the ramp generator. For this brief period of time (one pulse), comparator 4 compares the potential of junction R82, R83 with junction RT1, R84 of the bridge circuit. If the temperature at RT1 is low, the potential at the non-inverting terminal of comparator 4 is more negative and the output is -15 V.

The base of Q6 is zero, because of the voltage drops across R79 and R80. Therefore, Q6 conducts. Energy, stored in C38, flows through Q6 as current and capacitor C38 discharges to zero potential. No current flows through the primary winding of transformer T2.

At the end of the 100 microsecond pulse, the NPN transistor in the output of comparator 4 ceases to conduct, so the signal on the base of Q6 is +15V. Q6 ceases to conduct. C38 starts to charge, driving electrons (current) through the primary of T2. This induces a pulse into the secondary of T2 and to the gate of Triac Q7 turning it on.

At the beginning of the next 100 microsecond pulse, comparator 4 output is again -15V, with zero volts on the base of Q6. Q6 again conducts, discharging C38. At the end of the 100 microsecond pulse, Q6 ceases to conduct.

C38 charges and a pulse appears at the gate of Triac Q7, turning it on again.

The charging time for C38 is about one-half a time constant (C38, R87) and ten time constants (R81, C38) are available for discharging C38.

The above action is repeated as long as the temperature is low, causing an error between R82, R83 junction and RT1, R84 junction. As the temperature approaches the desired case temperature of 135°F (57°C), differences between these two junctions will exist for only part of each ramp and the number of pulses operating Q7 will be proportional to the amount of error sensed by the 6 Hz ramp.

The pulses arrive at Q7 just as the supply AC line voltage is passing the zero-volt crossover point. The purpose of C36 is to delay the timing pulse, relative to line frequency, so that a pulse arrives at the gate of Triac Q7 as the line potential just passes the zero-volt crossover point (0° and 180° of line phase).

Varistor, RV1 is a temperature sensitive resistance device. When case temperature is low, such as ambient, the value of RV1 is low. Applying power at that temperature might cause a current surge to damage Triac Q7. RV1 with its low initial value of resistance acts as a bypass and most of the current is shunted through it. As the temperature increases and approaches the desired case temperature, the resistance of RV1 increases to a large value. This limits the current through it and gives fine control of the heater to Triac Q7 and the temperature-sensing circuit.

5-4 DETECTOR HEATER CONTROL CIRCUIT

Figure 5-4 below is a simplified heater control circuit drawing for the detector. Heaters 1 and 2 are actually connected in parallel and have a combined resistance of about 17 ohms.

The thermistor resistance (RT1) in the resistance bridge varies inversely with temperature. The bridge is designed to maintain the temperature of the detector at 150°F (65.5°C).

The junction point between R55 and R56 is maintained at a specific voltage since these resistances maintain a definite ratio. The thermistor resistance is 149 K at 150°F (65.5°C) and increases rapidly as the temperature decreases. R59 in this bridge circuit represents the setpoint value for temperature. Suppose that, at temperature, resistance of the bridge (R55, R56, R59 and RT1) equals 149 K.

If the temperature goes down, RT1 increases in resistance and causes the junction of RT1 and R59 to go positive in voltage value. Since R55 and R56 are of equal resistance, their junction is at zero volts. Therefore, terminal 3 of AR6 is more positive than terminal 2 and the base of Q2 is positive. Q2 conducts, allowing alternating current to flow through heaters 1 and 2. The voltage drop across the heaters, when completely cold, would be about 20 VAC and, when controlling, would be AC of very low amplitude.

As the temperature increases, the resistance of RT1 decreases and the junction point between RT1 and R59 becomes less positive. Terminal 3 of AR6 becomes less positive with respect to terminal 2. The output of AR causes Q2 and Q3 to conduct less. When terminal 3 equals terminal 2, or is less than terminal 2, the output of AR6 is zero or less. Q2 and Q3 do not conduct and the heater would not be supplying heat energy to the detector.

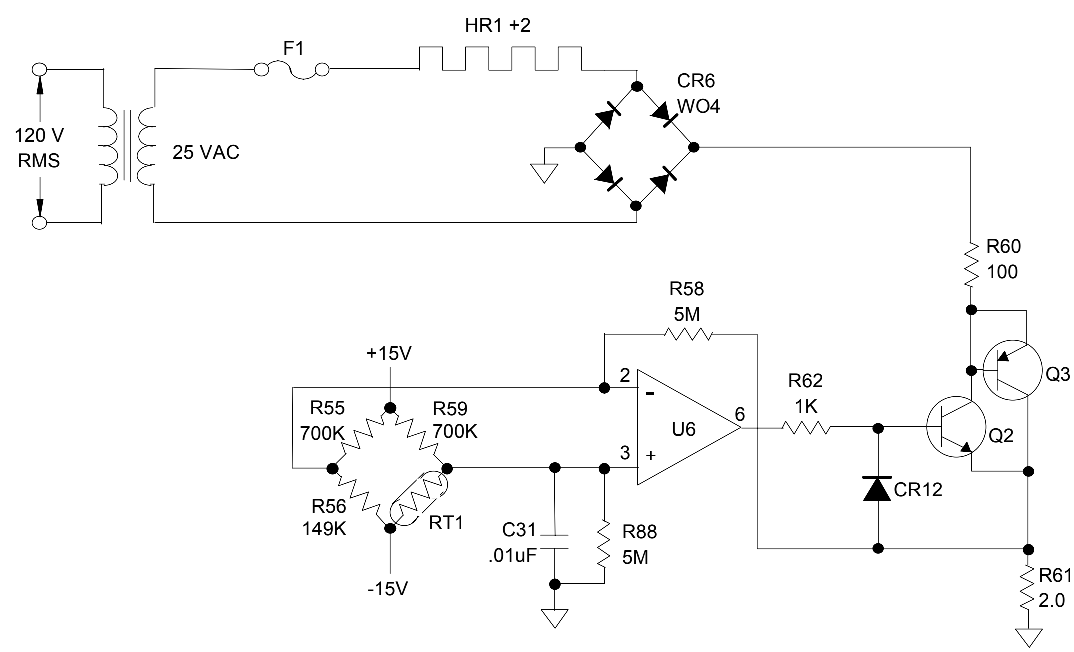


Figure 5-4. Detector Heater Control Circuit

5-5 DETECTOR LIGHT SOURCE CONTROL CIRCUIT

Refer to Figure 5-5 below. The detector light source control circuit maintains the light output from the bulb (DS1) as uniform as possible, regardless of voltage fluctuations or aging of the bulb.

The power source for the light bulb is a center-tapped secondary of transformer T1. This AC voltage is rectified by CR7 and CR8 and filtered (C32), presenting an approximate +8.5 V bus to the current-limiting Darlington configuration of Q4.

Q4 controls the basic amount of current through DS1.

Amplifier AR7 has a fixed value, approximately +2.2 VDC on terminal 3. The output of AR7 is positive, causing Q4 to conduct. As Q4 conducts, electrons flow from the center-tap of T1 to ground and from ground through DS1 for an input voltage to terminal 2 of AR7, through R66 to develop a bias on the base of Q5, through Q4 to the +8.5 V bus, and back to the secondary. As Q5 conducts, some of the current going through DS1 is shunted from the main current path, and goes through Q5, which acts as a variable feedback resistance, goes to the positive output potential of AR7.

As DS1 ages, its light emission decreases and its resistance increases. The current through DS1 tends to decrease, causing a decrease in the voltage drop across DS1 and the input potential to terminal 2 of AR7. Now the output AR7 will increase, causing Q4 to conduct more current through R66. As the potential across R66 increases, Q5 will conduct more current, causing a further increase in current flow through DS1. The net result is that the voltage across DS1 will remain uniform and the operation of Q4 and Q5 will adjust the gain of AR7 to maintain the light emission from DS1 uniform for a long period of time.

Voltage fluctuations in the 115 VAC supply could cause some variation in the amount of current flowing through the bulb DS1. However, the voltage drop across DS1 would cause AR7 to adjust Q4 and the voltage drop across R66 to adjust Q5. The net result would still be uniform current flow through DS1 and uniform light emission.

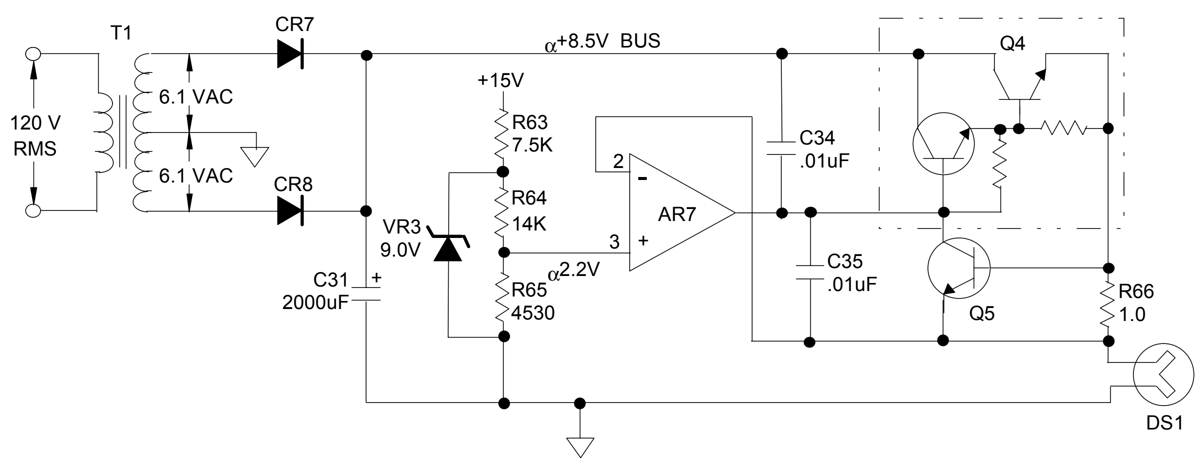


Figure 5-5. Detector Light Source Control Circuit

5-6 DETECTOR WITH FIRST STAGE AMPLIFIER

Refer to Figure 5-6, page 5-9. The detector assembly consists of a test body suspended on a platinum wire and located in a non-uniform magnetic field.

The test body is constructed of two hollow glass spheres forming a dumbbell shape. They are filled and sealed with pure, dry nitrogen. Around the test body, a titanium wire is chemically etched in order to form a feedback loop that can create a counteracting magnetic force to the test body displacement caused by oxygen concentration in the test assembly magnetic field.

Attached to the center arm of the test body dumbbell is a diamond-shaped mirror. Attached to the mirror are two separate platinum wires in tension with the supports for the test body. The supports are isolated from ground and are electrically connected to the feedback loop and the electronics for that loop. The platinum wires form a fulcrum around which the test body pivots.

The detector operates in the following fashion. If the sample gas contains oxygen, it collects in the non-uniform magnetic field around the test body. Oxygen, because of its paramagnetic qualities, gathers along the magnetic lines of flux and forces the dumbbell of the test body out of the magnetic field.

A light source is focused on the test body mirror. As the test body moves out of the magnetic field, the mirror distributes light unevenly on two photocells (BT1 and BT2). The photocells create a current proportional to light. This current is converted to a ± voltage by U1 and U2 located on the connector board in the detector housing. This voltage is then presented to comparator U1 on the controller board. The output of U1 goes to U2. The output of U2 causes current to flow through the feedback loop attached to the dumbbell.

This feedback current creates an electro-magnetic field that attracts the dumbbell and mirror into the test assembly magnetic field until the mirror reflects light almost uniformly on each photocell. A current proportional to the oxygen concentration in the magnetic field of the test assembly has to be flowing through the feedback loop in order to maintain balance and provide a reading of the oxygen content of a sample.

Resistances R7, R8 and the resistance of the wire in the feedback loop determine the gain of amplifier U2. The mirror on the dumbbell is positioned by the amount of current in the feedback loop. The mirror reflects light from the source (DS1) to the photocells (BT1, BT2). This repositioning of the mirror is a form of mechanical feedback to the input of the amplifier U1.

The net result is that the output of U1 could vary from 0 to -70 mV, or 0 to -7.0 V, depending on the range of the instrument. R4, C3 and R5, C7 form damping circuits for the input amplifier U1 and to smooth out noise that might be introduced by the measurement source.

Diode CR2 is a low-leakage device. Its purpose in the circuit is to ensure that the dumbbell and mirror are positioned correctly with respect to the photocells on initial application of power.

If the dumbbell was out of position on start-up, the mirror might reflect light from the source onto one of the photocells. If the photocell output was positive, the current in the feedback loop would be in the wrong direction and its electromagnetic field would cause the dumbbell to be further repelled from the permanent magnetic field. The result would be error, not balance.

On application of AC power, capacitor C1 has no charge. The current will have to flow through R2. Initially the full 30 V drop (the difference between the +15 VDC and -15 VDC power) will appear cross R2. The cathode of CR2 will be initially at -15 VDC. The anode of CR2 will be some value more positive than -15 VDC. CR2 will conduct. The input terminal of U1 will be negative and the current through the feedback loop around U2 will cause the dumbbell and mirror to be positioned correctly in the test body.

As the charge on C1 increases, the cathode of CR2 becomes more positive. When it exceeds that on the anode, CR2 ceases to conduct and isolates the +15 VDC and -15 VDC power supply from the input circuit.

The front panel zero potentiometer R13 and detector coarse zero potentiometer add or subtract current to the input of U2 to offset any currents that may occur because of any imbalance in the detector and the photocells BT1 and BT2.

The output current that U2 must provide to restore the dumbbell is a measure of the displacing force and thus is a function of both (a) the % oxygen concentration of the sample and (b) the sample pressure.

The output from the U1 and U2 loop is further amplified by U4 to provide a 0 to 10 VDC output that constitutes signal V.

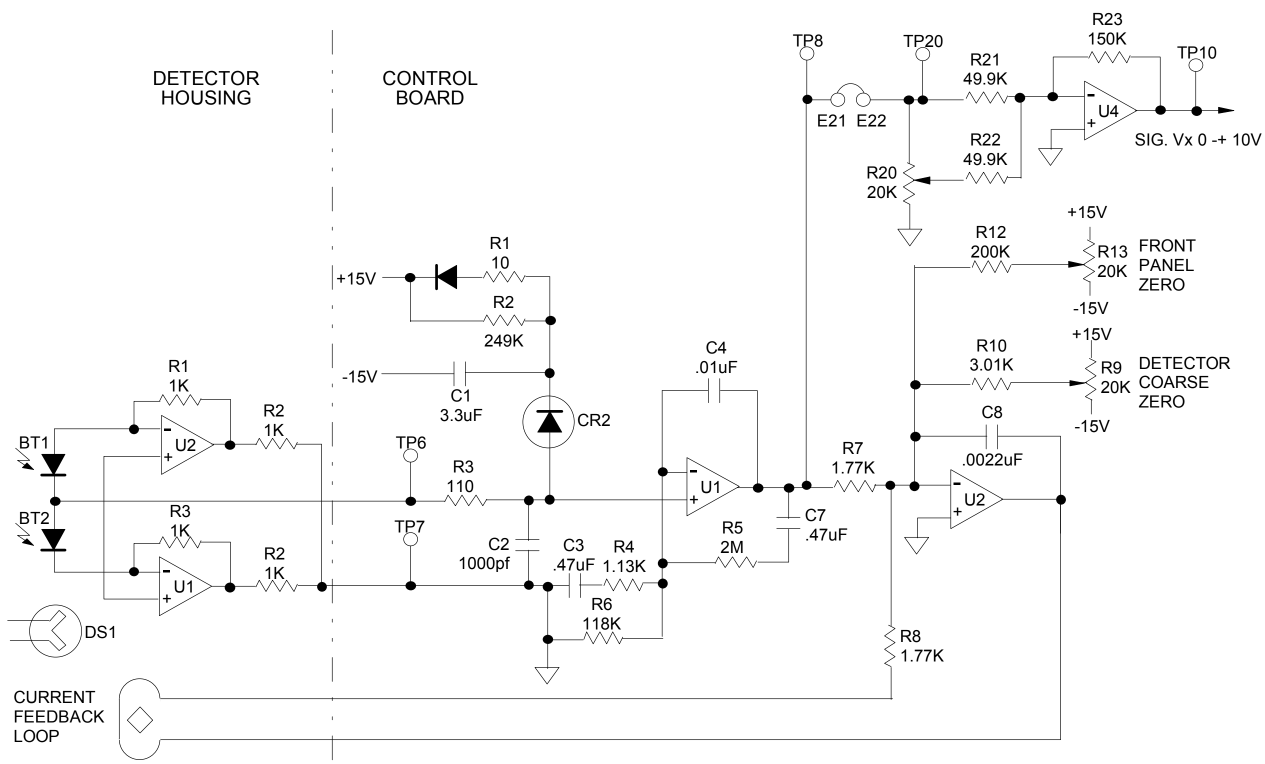


Figure 5-6. Detector with First Stage Amplifier

5-7 BUFFER AMPLIFIERS U8 AND U10 WITH ASSOCIATED ANTICIPATION FUNCTION

Refer to Figure 5-8, page 5-12. U8 is a unity gain amplifier that provides zeroing capability and a buffered output for the anticipation circuit feeding U10.

U10 is an inverting buffer amplifier that incorporates an anticipation arrangement in its input network, thus providing slightly faster response on the readout device(s).

Potentiometer R30 provides a continuously variable adjustment of 5 to 25 seconds for the electronic response time (90% of fullscale) and is factory-set for 20 seconds.

Since the anticipation network attenuates the signal, a gain of 10 is provided by the feedback network associated with U10 to restore the signal to the desired fullscale range of 0 to 10 VDC.

The output signal from U10 is routed to two output circuits:

Digital output circuit (See Section 5-8, page 5-10).

Analog output circuits for recorder, V/I and alarms (See Section 5-9, page 5-11).

5-8 DIGITAL OUTPUT CIRCUIT

Refer to Figure 5-7 below. The output signal from buffer amplifier U10 is routed through an attenuator and filter network to an integrating analog-to-digital converter. It converts the signal into an equivalent digital value in the range of 0.00% to 99.99%. Any value above 99.99% will be preceded by an over-range bit, for example, 1.1123.

The output of the ADC consists of binary-coded decimal characters that are input to the liquid crystal controller and display chip characters sequentially in time. The BCD characters are converted into seven-line codes to drive the bar segments of the liquid crystal display.

A separate regulator circuit, which operates from the +15 VDC supply, provides a regulated 5 VDC for the digital functions associated with the display.

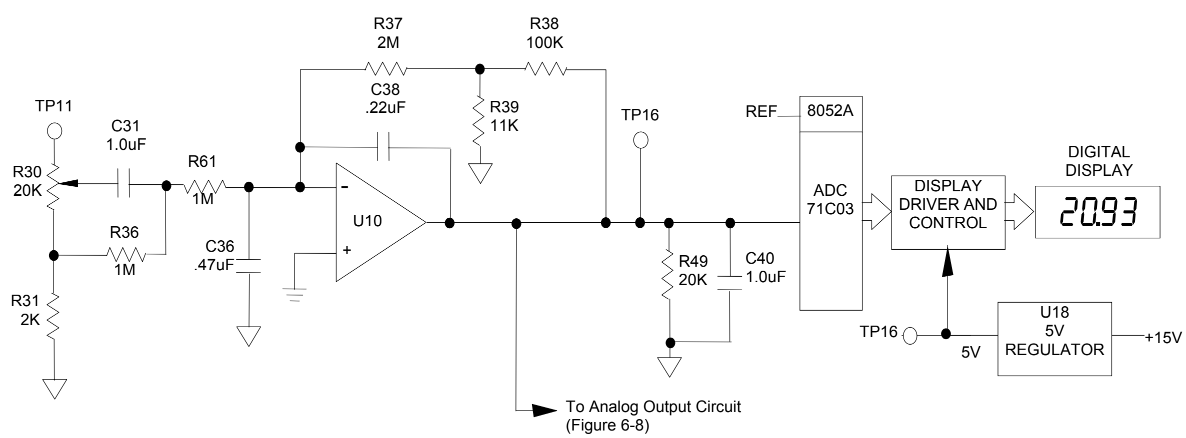


Figure 5-7. Buffer, Anticipation, and Digital Output Circuits

5-9 ANALOG OUTPUT CIRCUITS FOR RECORDER AND ALARMS

Refer to Figure 5-8, page 5-12. The analog output circuits utilize two amplifiers, first-stage amplifier and second-stage amplifier.

a. First Stage Amplifier

Permits selection of the desired fullscale oxygen range for the recorder via jumper-selectable signal amplification for scale expansion. This amplifier permits selecting the desired fullscale oxygen range for the recorder by an appropriate jumper selection of one of seven recorder spans. The following recorder spans are available: 1, 2.5, 5, 10, 25, 50, and 100%.

b. Second Stage Amplifier

Provides (a) a jumper-selectable output for a potentiometric recorder and (b) an output to drive the voltage-to-current and/or alarm option(s), if used. This amplifier is an inverting configuration that provides a signal attenuation of 2X, thus reducing the 10-volt fullscale input signal to obtain a 5-volt fullscale output. This output is routed to:

1. Recorder Output Resistor Network. It provides a jumper-selectable output of 0 to 10 mV, 0 to 100 mV, 0 to 1 V, or 0 to 5 VDC for a potentiometric recorder.
2. Current Output Receptacle J1. This connector accepts the optional plug-in current-output board.
3. Dual Alarm Amplifier Circuit. This circuit drives the optional 654019 Alarm Relay Assembly.

Oxygen is strongly paramagnetic while most other common gases are weakly diamagnetic. The paramagnetism of oxygen may be regarded as the capability of an oxygen molecule to become a temporary magnet when placed in a magnetic field. This is analogous to the magnetization of a piece of soft iron. Diamagnetic gases are analogous to non-magnetic substances.

With the Model 755R, the volume magnetic susceptibility of the flowing gas sample is sensed in the detector/magnet assembly. As shown in the functional diagram of Figure 5-1 (page 5-2), a dumbbell-shaped, nitrogen-filled, hollow glass test body is suspended on a platinum/nickel alloy ribbon in a non-uniform magnetic field.

Because of the “magnetic buoyancy” effect, the spheres of the test body are subjected to displacement forces, resulting in a displacement torque that is proportional to the volume magnetic susceptibility of the gas surrounding the test body.

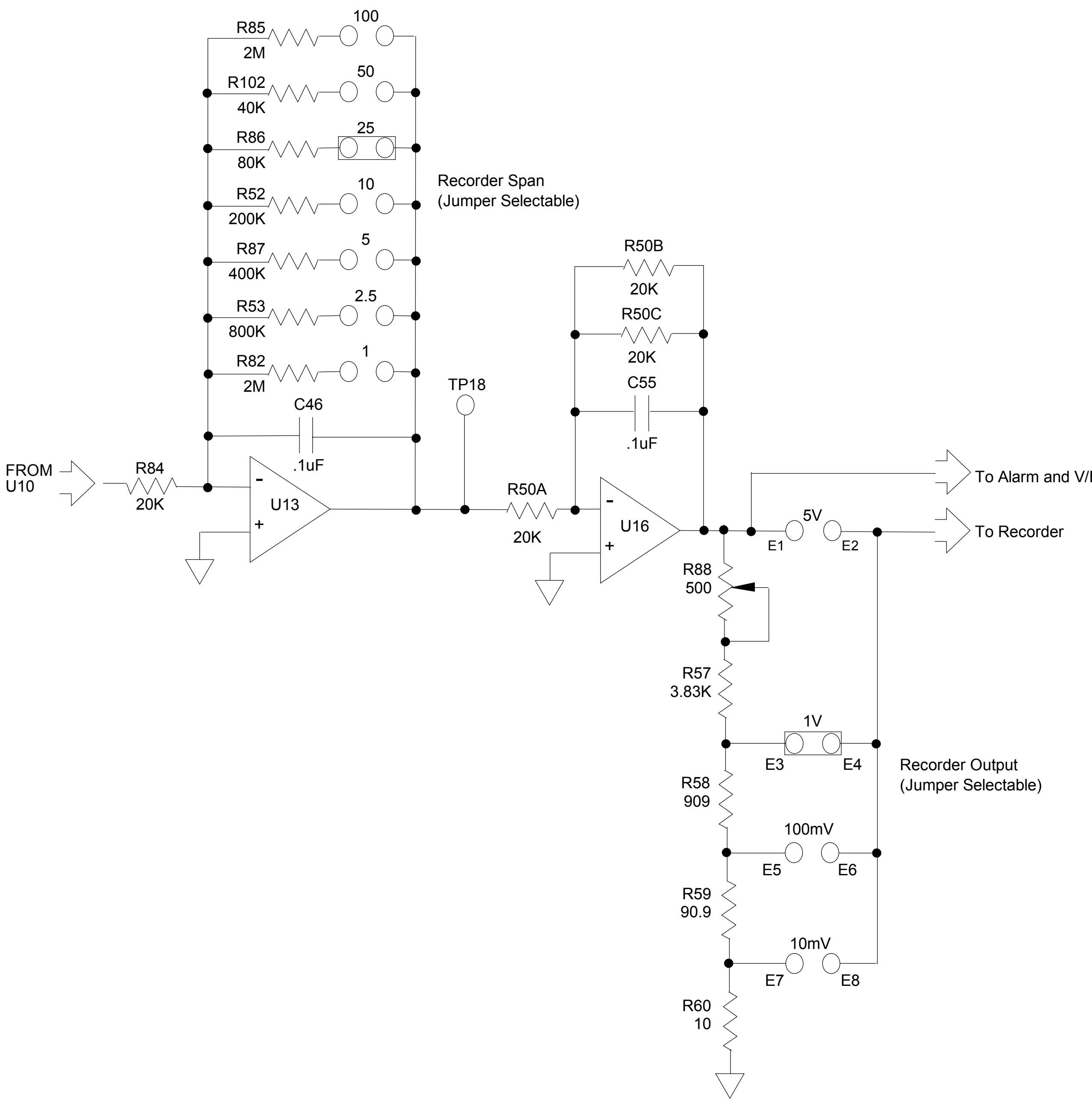


Figure 5-8. Simplified Analog Recorder Output Circuit

SECTION 6
MAINTENANCE AND SERVICE

The information provided in this section will aid in isolation of a malfunction to a particular assembly or circuit board. A few detailed checks are included, to aide in locating the defective assembly.

It is recommended that those familiar with circuit analysis, refer to Section 6 Circuit Analysis of this manual.

WARNING

ELECTRICAL SHOCK HAZARD

Do not operate without doors and covers secure. Servicing requires access to live parts which can cause death or serious injury. Refer servicing to qualified personnel.

For safety and proper performance this instrument must be connected to a properly grounded three-wire source of power.

Optional alarm switching relay contacts wired to separate power sources must be disconnected before servicing.

WARNING

PARTS INTEGRITY

Tampering or unauthorized substitution of components may adversely affect safety of this product. Use only factory documented components for repair

6-1 INITIAL CHECKOUT WITH STANDARD GASES

If instrument readings do not meet specifications, the first step in troubleshooting is to isolate the analyzer from the sample stream and the sample handling system.

Admit zero and span standard gases to the analyzer. Observe readout on digital display, and on recorder, if used.

Digital display gives correct reading with standard gases, but not with sample gas

The sample and the sample handling system are suspect. Check these areas.

Digital display gives correct readings with standard gases, but the alarm or output devices do not

Check these devices individually.

Digital display gives overrange readings with standard gases, as well as sample gas

The problem is likely with detector or the electronic circuitry. Turn power OFF. Tap detector compartment with fingers, wait 30 seconds, reapply power. If the suspension within the detector assembly is hung up, this may correct the problem. If not, proceed with checks of the detector and electronic circuitry.

Digital display gives erratic readings with standard gases, as well as sample gas

If zero and span standard gases give noisy or drifting readings, the problem is probably in the detector or the temperature control circuits. Proceed with checks of the detector and electronics. In general, before concluding that the detector is defective and must be replaced, verify correct operation of all circuits that could cause erratic readings.

a. Control Board Checkout

The Detector Isolation Plug located on the Control Board (Figure 3-1, page 3-3), removes the detector signal, allowing the input voltage to go to zero. The display should register near zero or on scale, and TP20 should read zero voltage. To test the remainder of the measuring circuit, do the following:

Voltage

1. Set RANGE Select to lowest range.

2. Adjust R29 clockwise and counter-clockwise. The display should follow accordingly and remain steady within the adjustment limits of R29. If this condition is met, refer to Section 6-6a (page 6-7) for Control Board setup. Before replacing the Control Board, test for -15V at the junction of C1/J4-7. Use the junction of CR1/R2 for +15V, or any source of ±15V on the board for the respective voltages.

3. If adjustment of R29 is not possible, replace the Control Board.

Alarms

Set RANGE Select to lowest range or use zero and span gases.

Current Output

Set RANGE Select to lowest range or use zero and span gases.

When checkout complete, re-install Detector Isolation Plug. Configure Control Board to original setup.

If the Control Board functions correctly, the problem is either located in the Detector/Magnet Assembly or related to temperature control.

6-2 HEATING CIRCUITS

To ensure against damage from overheating in the event of malfunction, the heating circuits receive power via thermal fuses F2 and F3. If temperature of a heated area exceeds the permissible maximum, the associated fuse melts, opening the circuit.

NOTE:

The thermal fuses should be plugged in, NOT SOLDERED, as the fuse element might melt and open the circuit.

a. Case Heater Control Circuit

The case heater control circuit receives power via thermal fuse F2 (setpoint 75°C). This fuse, accessible on the Power Supply Board, may be checked for continuity.

Detector compartment heater element HR3, mounted on the heater/fan assembly, has a normal resistance of 20 ohms.

To verify heater operation, carefully place a hand on top of detector compartment. Heat should be felt. If not, check the case heating circuit.

Temperature sensor RT1 has a cold resistance of 22.7K ohms and a normal operating resistance of 20.2K ohms, indicating normal operating temperature.

As a further check, disconnect plug P6 on the Control Board, thus disconnecting temperature sensor RT1. Substitute a decade resistor box to simulate the resistance of RT1. Also, connect an AC voltmeter from the hot side of the line to the neutral side of F2, located inside the detector compartment.

Set the decade box for 20.2K ohms to simulate RT1 at controlling temperature. The voltmeter should show pulses of 1 VAC.

CAUTION

OVERHEATING

Avoid prolonged operation with the decade box set at 22.2K ohms, overheating may result.

Set the decade box for 22.2K ohms to simulate RT1 resistance at ambient temperature. The voltmeter should show pulses of 120 VAC.

6-3 DETECTOR/MAGNET HEATING CIRCUIT

Heater HR1 is attached to the magnet. Heater HR2 is attached to the rear of the detector. Combined resistance of these two parallel-connected heaters, as measured at pins 15 and 16 of the detector connector J12, should be approximately 89 ohms.

If resistance is correct, and the combined resistance is incorrect, heater HR1 may be open.

To reach the leads of HR1, remove the circuit board on the heater assembly. Resistance of HR1 should be approximately 21 ohms.

To check operation of the heater circuit, connect a voltmeter across R61 on the Power Supply Board. Normally, the voltage will be 4 VDC when cold and will drop to approximately 0.4 VDC at control temperature. Temperature sensor RT1 is mounted in the detector, with leads accessible at pins 10 and 11 of detector connector J12. The sensor resistance should be 1M ohms at 25°C and approximately 149K ohms at operating temperature of 65°C.

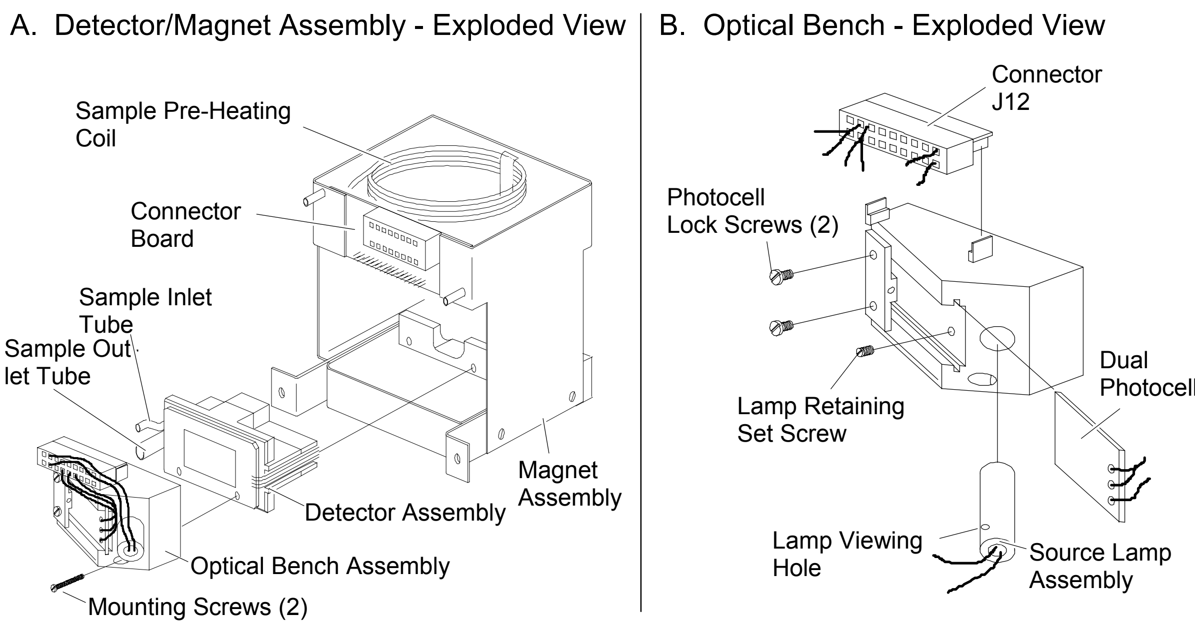


Figure 6-1. Detector/Magnet Assembly

6-4 DETECTOR CHECK

To isolate the detector as the problem, it is necessary to check the source lamp, photocells, and suspension (see Figure Figure 6-1B, page 6-3). These components are connected via J12 on the optical bench assembly.

Pin/leads may be removed from connector J12 by use of an improvised pin removal tool, such as a paper clip (see Figure 6-2 below).

Connect J12 has slots at top and bottom. To remove a connector pin/lead, insert the tool into the upper or lower slot and push down on the end to release the keeper on the pin.

When inserting a pin/lead, its keeper must face toward the slot opening in the connector in order to lock in. If inserted otherwise, the pin/lead will be forced out when the two connectors are joined.

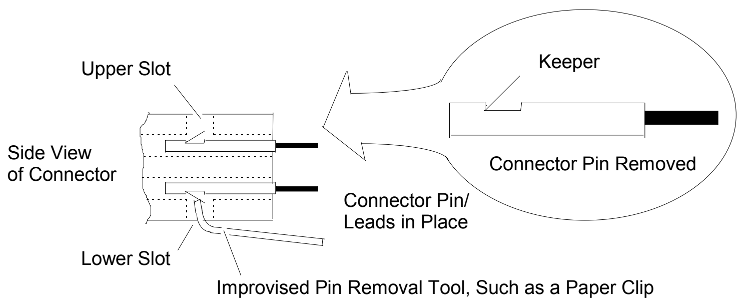


Figure 6-2. Pin/Lead Removal

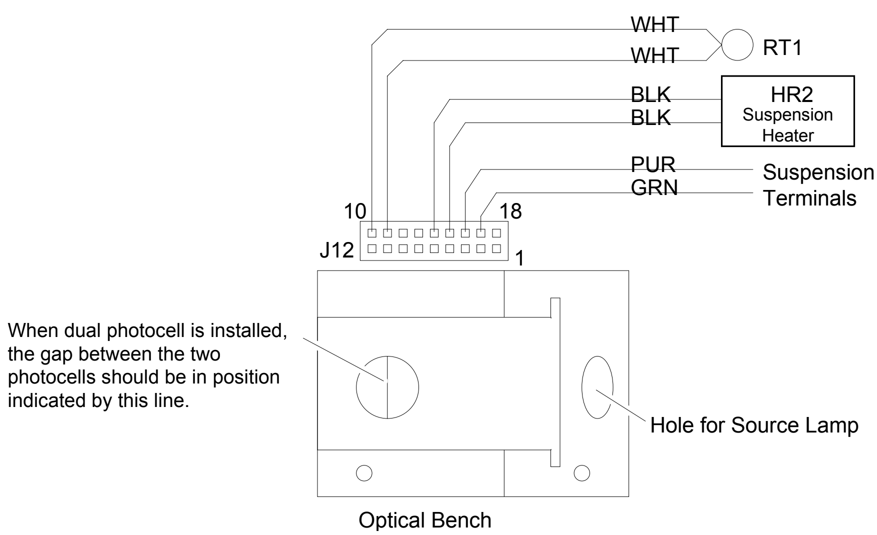


Figure 6-3. Detector Optical Bench

a. Source Lamp

The simplest check of the source lamp is to verify that it is lit. Another check is done by removing the housing cover and viewing the lamp through the photocell alignment hole (see Figure 6-3, page 6-4). If the photocell is not illuminated, test the voltage across TP2 to TP5 (ground). This voltage should be 2.2 V ±0.2 VDC. If reading is correct, the lamp may be burned out; also inspect the cable for continuity. If voltage reading is not 2.2 V ±0.2 VDC, the Power Supply Board must be replaced.

b. Photocell

If the photocells are on, observe through the photocell alignment hole. The image should be steady. Disconnect the line power and observe the image when you reconnect the power. It should come up from the side and seek a position that equally illuminates the photocells.

c. Suspension

Turn electrical power to instrument OFF. Remove optical bench assembly (see Figure 6-1A, page 6-3). With 100% nitrogen flowing through the analyzer, note position of the suspension. Then admit air and note response of the suspension. It should rotate clockwise as viewed from the top, and to the right as viewed though the window. Failure to rotate indicates that the suspension has been damaged and detector assembly must be replaced. See Section 6-5c, page 6-7.

If the suspension has been changed, the cause may be improper operating conditions.

6-5 REPLACEMENT OF DETECTOR/MAGNET COMPONENTS

a. Source Lamp

Removal/Installation

The source lamp is held in the optical bench assembly by a set screw (see Figure 6-1B, page 6-3). The two lamp leads are connected to J12.

The red line on the lamp base must align with the set screw (see Figure 6-4A). The base of the lamp should extend from the hole approximately 1/4 inch. Tighten set screw when lamp is aligned.

Realign the photocell per Section 6-5b, page 6-5.

b. Photocell

Removal/Installation

Refer to Figure 6-1B, page 6-3. Note location of photocell leads in connector J12. Remove leads. Remove photocell lock screws (2), slide photocell out.

Reverse the removal procedure for installation. Align photocell (see below).

Alignment

The adjustments in this procedure are made on the Control Board. With zero gas flowing:

1. Place a digital voltmeter between the wiper of zero potentiometer (R13) and TP7 (ground). Adjust for 0 VDC.

2. Remove the voltmeter from R13 and place on R10 (see Figure 6-4B, page 6-6). Adjust R9 for 0 VDC.

3. Remove the voltmeter from R10 and place on TP8. Move the photocell to obtain a DC voltage as close to 0 mV as possible, but no more than ±750 mV.

4. Apply power to instrument and allow to warm-up approximately one hour.

5. Set front panel ZERO at mid-range (i.e., five turns from either end).

6. Connect digital voltmeter from slider of R9 to chassis ground. With a steady flow of 50 to 500 cc/min of nitrogen zero gas going through instrument, adjust R9 for 0 V.

7. Connect the voltmeter between TP10 and circuit ground (TP7). Adjust front panel ZERO for reading of exactly zero on voltmeter.

All internal adjustments are now properly set. The instrument may be calibrated per Section 3-4, page 3-1.

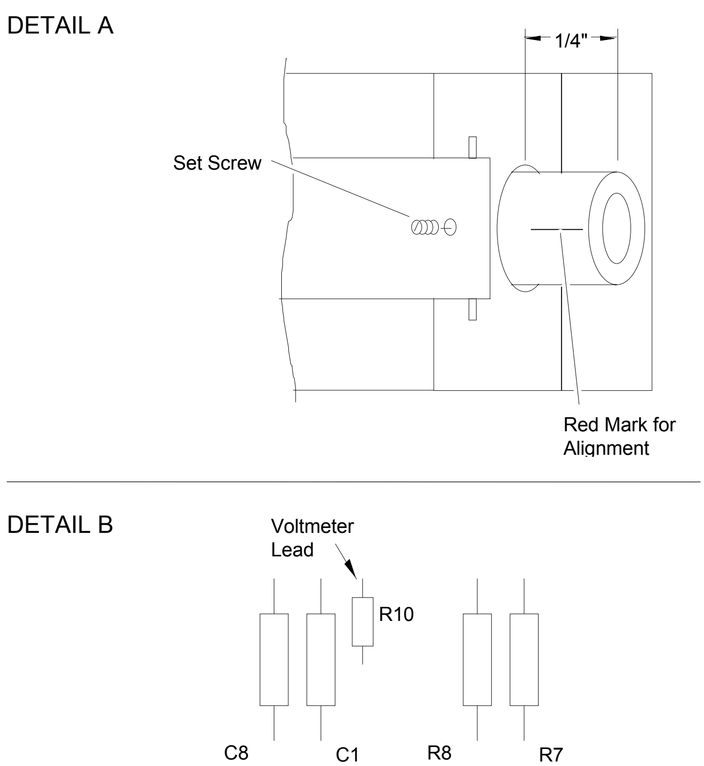


Figure 6-4. Lamp Replacement

c. Detector

Removal

Prior to removal of the detector, remove power from instrument and stop flow of sample gas.

1. Remove the four screws securing the detector cover plate.

2. Disconnect cable from J12 on the detector assembly.

NOTE:

Note how the rubber sample lines are looped into a "long coil". When reinstalling the sample lines they must be configured in the same way. This precaution isolates the detector from the effects of mechanical vibration. Otherwise vibration waves could travel upward along the tubing walls, resulting in noisy readout.

3. Refer to Figure 6-1, page 6-3. Using needle-nose pliers, squeeze the hose clamps to disconnect the rubber sample lines from the metal inlet and outlet tubes of the detector assembly.

4. Remove the two screws at the bottom of the detector assembly, slide detector out.

Installation

1. Install replacement detector assembly and connect cable to J12.

2. Seat the detector assembly firmly against the magnet pole pieces and tighten attaching screws.

3. Reconnect rubber sample lines to metal inlet and outlet tubes on detector assembly.

4. Apply power to instrument and allow to warm up approximately one hour.

Calibration

1. On the Control Board, set the front panel ZERO control (R13) at mid-range (i.e., five turns from either end).

2. Connect a digital voltmeter from the slider of R9 to chassis ground. With a steady flow of 50 to 500 cc/min. of nitrogen gas passing through the instrument, adjust R9 for zero volts.

3. Connect the voltmeter between TP10 and circuit ground (TP7). Adjust front panel ZERO control (R13) for reading of exactly zero on voltmeter.

4. With all internal adjustments now properly set, the instrument may be calibrated per Section 3-4, page 3-1.

6-6 CONTROL BOARD SETUP

a. Power Supply Test

1. TP7 (circuit ground) is ground point for all voltage tests.

2. Counterclockwise end of front panel ZERO potentiometer (R13 on Control Board): -15 VDC ±0.5 VDC.

3. Clockwise end of ZERO potentiometer: +15 VDC ±5 VDC.

4. Set ZERO potentiometer to obtain a reading of .0 VDC ±10 mV at slider.

5. Measure TP19: +5 VDC ±0.25 VDC.

b. Detector zero

1. Flow 250 cc/min nitrogen.

2. Monitor TP8, adjust R9 for 0 VDC ±2mV.

c. U4 Zero

1. Monitor TP5, adjust R100 for 1 VDC ±2mV.

2. Monitor TP10, adjust R13 (ZERO) for 0.0 VDC ±5mV.

d. U8 Zero

Monitor TP11, adjust R29 for 0.0 VDC ±5mV.

e. U10 Zero

1. Monitor TP16, adjust R29 for 0.0 VDC ±5mV.

NOTE:

This adjustment requires a "long time" constant. Allow adequate time.

2. Adjust R29 to obtain a reading of 00.00 ±5 counts on the display.

f. Fullscale

1. Monitor TP11. Flow 100% oxygen, adjust SPAN potentiometer R20 for 10.00 V ±5mV.

2. Monitor TP16, adjust R20 for 10.00 V ±5mV. The display must read 100.00 ±5 counts.

g. Recorder Fullscale

1. Flow nitrogen at 250 cc/min, monitor TP16, and adjust front panel ZERO potentiometer for .000 VDC.

2. Flow 100% oxygen for span gas. Recorder output for 1 V, 100 mV, or 10 mV should read 100% of span gas. Adjust R88 if necessary.

SECTION 7
REPLACEMENT PARTS

The following parts are recommended for routine maintenance and troubleshooting of the Model 755R Oxygen Analyzer. If the troubleshooting procedures do not resolve the problem, contact Rosemount Analytical Customer Service Center.

WARNING

PARTS INTEGRITY

Tampering or unauthorized substitution of components may adversely affect safety of this product. Use only factory-documented components for repair.

7-1 CIRCUIT BOARD REPLACEMENT POLICY

In most situations involving a malfunction of a circuit board, it is more practical to replace the board than to attempt isolation and replacement of the individual component. The cost of test and replacement will exceed the cost of a rebuilt assembly. As standard policy, rebuilt boards are available on an exchange basis.

Because of the exchange policy covering circuit boards the following list does not include individual electronic components. If circumstances necessitate replacement of an individual component, which can be identified by inspection or from the schematic diagrams, obtain the replacement component from a local source of supply.

7-2 MATRIX – MODEL 755R OXYGEN ANALYZER

755R	Model 755R Oxygen Analyzer

Code	Ranges
01	0-5, 10, 25, 50, and 100% O_2 (Standard)
02	0-1, 2.5, 5, 10, 25, 50, and 100% O_2 (Extended)
99	Special

Code	Output
01	0-10 mV, 0-100 mV, 0-1 V or 0-5 VDC (Standard)
02	0, 4-20 mA (Current)
99	Special

Code	Alarm Relays
00	No Alarm
01	Dual Alarm
99	Special

Code	Case
01	Standard
02	Standard with Tropicalization
03	EMC Kit
04	EMC Kit with Tropicalization
99	Special

Code	Operation
01	115 VAC, 50/60 Hz (Standard)
02	230 VAC, 50/60 Hz
99	Special

Code	Remote Range
00	None
01	Standard (0-5, 10, 25, 50, 100%)
02	Extended (0-1, 2.5, 5, 10, 25%)(1)
03	0-1, 2.5, 5, 10, 50%(1)
04	0-1, 2.5, 5, 25, 50%(1)
05	0-1, 2.5, 5, 25, 100%(1)
06	0-1, 2.5, 10, 25, 100%(1)
99	Special

Code	Feature
00	Features as selected
99	Special

755R	01	01	01	01	01	00	00	Example

7-3 SELECTED REPLACEMENT PARTS

092114	Fuse, 1/2A (240VAC) (Package of 5)
777362	Fuse, Heater 3A (120VAC) (Package of 15)
777361	Fuse, Heater 1.5A (240VAC) (Package of 15)
861649	Thermal Fuse (F2,F3)
656189	Detector/Optical Bench Assembly (0 to 1%)
616418	Source Lamp Kit
622356	Photocell
621023	Current Output Board (0 to 20mA, 4 to 20mA)
622351	Connector Board
631773	Power Supply Board
652830	Control Board Kit
654004	Thermistor - Case Heater
654022	Display Assembly
654078	Viton Tubing (Sample In)
654079	Viton Tubing (Sample Out)
654080	Fan Assembly
654081	Case Heater
809374	Fuse, 3/4A (Power Transformer, 115VAC)
860371	Alarm Relay
645407	Shock Mount (Package of 4)

SECTION 8
RETURN OF MATERIAL

8-1 RETURN OF MATERIAL

If factory repair of defective equipment is required, proceed as follows:

1. Secure a return authorization from a Rosemount Analytical Inc. Sales Office or Representative before returning the equipment. Equipment must be returned with complete identification in accordance with Rosemount instructions or it will not be accepted.

   Rosemount CSC will provide the shipping address for your instrument.

   In no event will Rosemount be responsible for equipment returned without proper authorization and identification.

2. Carefully pack the defective unit in a sturdy box with sufficient shock absorbing material to ensure no additional damage occurs during shipping.

3. In a cover letter, describe completely:

   - The symptoms that determined the equipment is faulty.
   - The environment in which the equipment was operating (housing, weather, vibration, dust, etc.).
   - Site from where the equipment was removed.
   - Whether warranty or non-warranty service is expected.
   - Complete shipping instructions for the return of the equipment.

4. Enclose a cover letter and purchase order and ship the defective equipment according to instructions provided in the Rosemount Return Authorization, prepaid, to the address provided by Rosemount CSC.

Rosemount Analytical Inc.
Process Analytical Division
Customer Service Center
1-800-433-6076

If warranty service is expected, the defective unit will be carefully inspected and tested at the factory. If the failure was due to the conditions listed in the standard Rosemount warranty, the defective unit will be repaired or replaced at Rosemount's option, and an operating unit will be returned to the customer in accordance with the shipping instructions furnished in the cover letter.

For equipment no longer under warranty, the equipment will be repaired at the factory and returned as directed by the purchase order and shipping instructions.

8-2 CUSTOMER SERVICE

For order administration, replacement Parts, application assistance, on-site or factory repair, service or maintenance contract information, contact:

Rosemount Analytical Inc.
Process Analytical Division
Customer Service Center
1-800-433-6076

8-3 TRAINING

A comprehensive Factory Training Program of operator and service classes is available. For a copy of the *Current Operator and Service Training Schedule* contact the Technical Services Department at:

Rosemount Analytical Inc.
Customer Service Center
1-800-433-6076

WARRANTY

Goods and part(s) (excluding consumables) manufactured by Seller are warranted to be free from defects in workmanship and material under normal use and service for a period of twelve (12) months from the date of shipment by Seller. Consumables, glass electrodes, membranes, liquid junctions, electrolyte, o-rings, etc., are warranted to be free from defects in workmanship and material under normal use and service for a period of ninety (90) days from date of shipment by Seller. Goods, part(s) and consumables proven by Seller to be defective in workmanship and/or material shall be replaced or repaired, free of charge, F.O.B. Seller's factory provided that the goods, part(s) or consumables are returned to Seller's designated factory, transportation charges prepaid, within the twelve (12) month period of warranty in the case of goods and part(s), and in the case of consumables, within the ninety (90) day period of warranty. This warranty shall be in effect for replacement or repaired goods, part(s) and the remaining portion of the ninety (90) day warranty in the case of consumables. A defect in goods, part(s) and consumables of the commercial unit shall not operate to condemn such commercial unit when such goods, part(s) and consumables are capable of being renewed, repaired or replaced.

The Seller shall not be liable to the Buyer, or to any other person, for the loss or damage directly or indirectly, arising from the use of the equipment or goods, from breach of any warranty, or from any other cause. All other warranties, expressed or implied are hereby excluded.

IN CONSIDERATION OF THE HEREIN STATED PURCHASE PRICE OF THE GOODS, SELLER GRANTS ONLY THE ABOVE STATED EXPRESS WARRANTY. NO OTHER WARRANTIES ARE GRANTED INCLUDING, BUT NOT LIMITED TO, EXPRESS AND IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Limitations of Remedy. SELLER SHALL NOT BE LIABLE FOR DAMAGES CAUSED BY DELAY IN PERFORMANCE. THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF WARRANTY SHALL BE LIMITED TO REPAIR OR REPLACEMENT UNDER THE STANDARD WARRANTY CLAUSE. IN NO CASE, REGARDLESS OF THE FORM OF THE CAUSE OF ACTION, SHALL SELLER'S LIABILITY EXCEED THE PRICE TO BUYER OF THE SPECIFIC GOODS MANUFACTURED BY SELLER GIVING RISE TO THE CAUSE OF ACTION. BUYER AGREES THAT IN NO EVENT SHALL SELLER'S LIABILITY EXTEND TO INCLUDE INCIDENTAL OR CONSEQUENTIAL DAMAGES. CONSEQUENTIAL DAMAGES SHALL INCLUDE, BUT ARE NOT LIMITED TO, LOSS OF ANTICIPATED PROFITS, LOSS OF USE, LOSS OF REVENUE, COST OF CAPITAL AND DAMAGE OR LOSS OF OTHER PROPERTY OR EQUIPMENT. IN NO EVENT SHALL SELLER BE OBLIGATED TO INDEMNIFY BUYER IN ANY MANNER NOR SHALL SELLER BE LIABLE FOR PROPERTY DAMAGE AND/OR THIRD PARTY CLAIMS COVERED BY UMBRELLA INSURANCE AND/OR INDEMNITY COVERAGE PROVIDED TO BUYER, ITS ASSIGNS, AND EACH SUCCESSOR INTEREST TO THE GOODS PROVIDED HEREUNDER.

Force Majeure. Seller shall not be liable for failure to perform due to labor strikes or acts beyond Seller's direct control.

Emerson Process Management

Rosemount Analytical Inc.
Process Analytic Division
1201 N. Main St.
Orrville, OH 44667-0901
T (330) 682-9010
F (330) 684-4434
E gas.csc@emersonprocess.com

Fisher-Rosemount GmbH & Co.
Industriestrasse 1
63594 Hasselroth
Germany
T 49-6055-884 0
F 49-6055-884209

ASIA - PACIFIC
Fisher-Rosemount
Singapore Private Ltd.
1 Pandan Crescent
Singapore 128461
Republic of Singapore
T 65-777-8211
F 65-777-0947

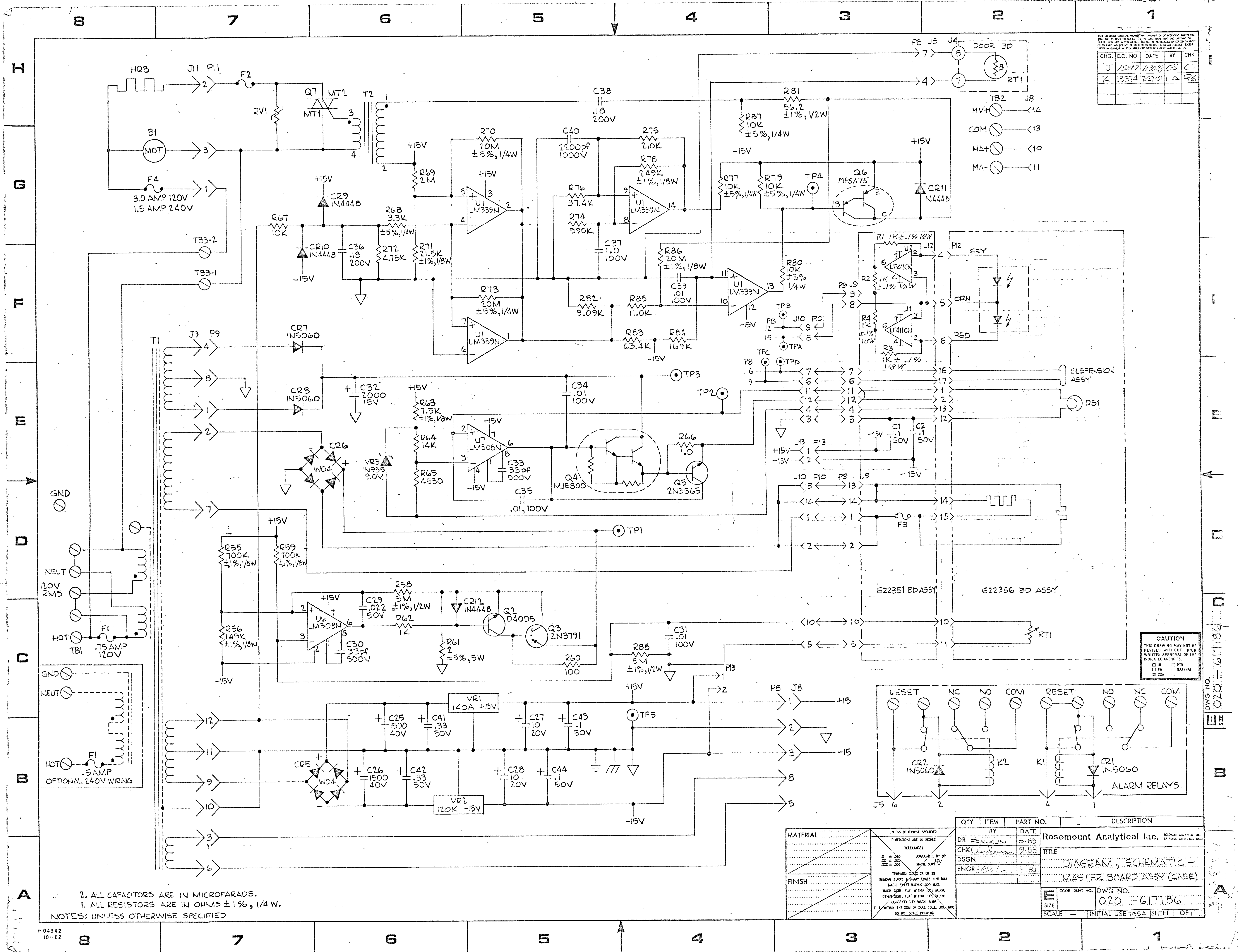
EUROPE, MIDDLE EAST, AFRICA
Fisher-Rosemount Ltd.
Heath Place
Bognor Regis
West Sussex PO22 9SH
England
T 44-1243-863121
F 44-1243-845354

LATIN AMERICA
Fisher - Rosemount
Av. das Americas
3333 sala 1004
Rio de Janeiro, RJ
Brazil 22631-003
T 55-21-2431-1882

http://www.processanalytic.com

© Rosemount Analytical Inc. 2001

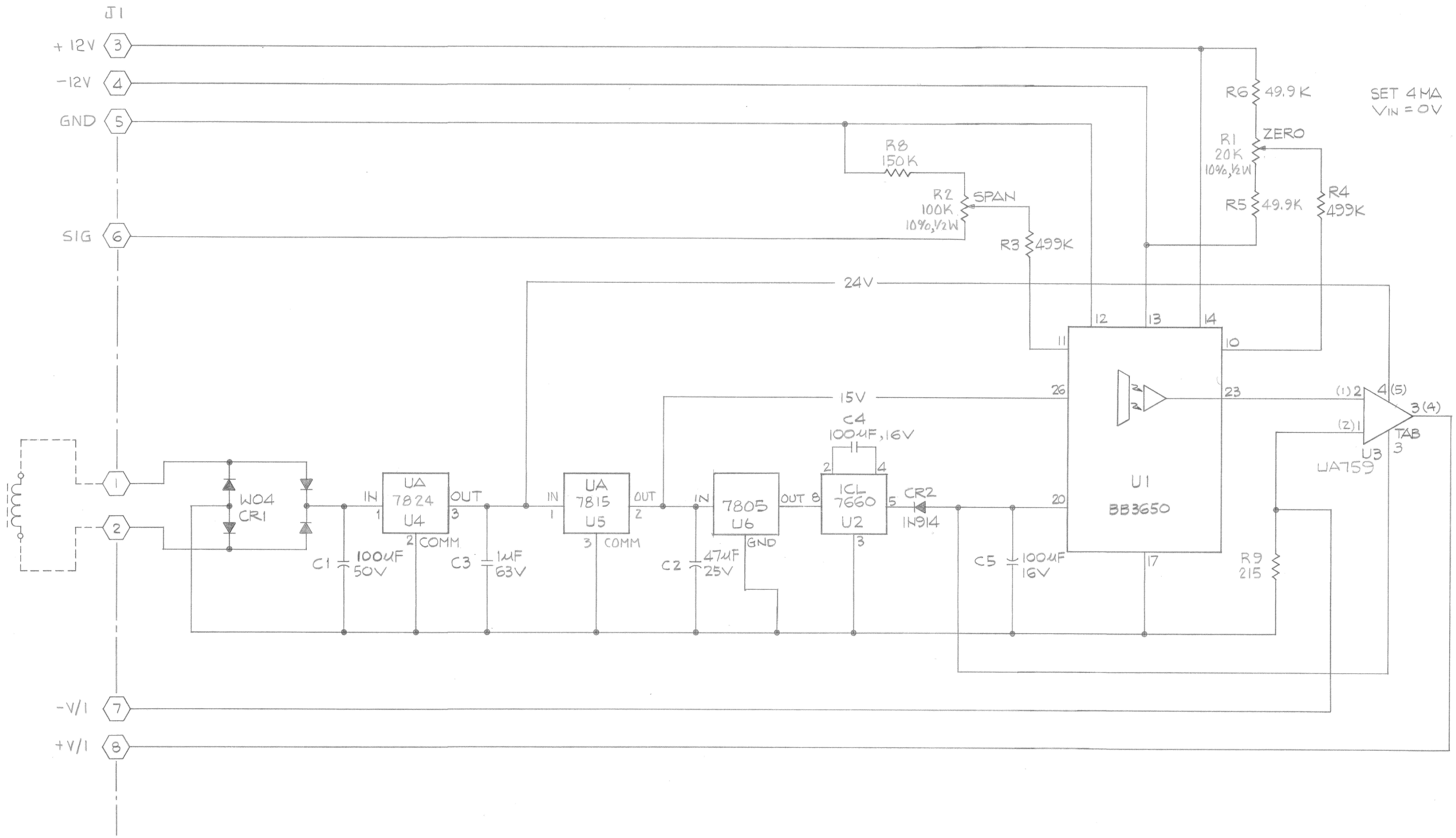
EMERSON
Process Management



HR3
J11 P11
F2
RV1
Q7 MT2
MT1
T2
B1
MOT
F4
3.0 AMP 120V
1.5 AMP 240V
TB3-2
TB3-1
C38 .18 200V
R81 56.2 ±1%, 1/2W
R87 10K ±5%, 1/4W
R70 20M ±5%, 1/4W
C40 2200pf 1000V
R75 210K
R78 249K ±1%, 1/8W
R69 2M
CR9 1N4448
R68 3.3K ±5%, 1/4W
R67 10K
CR10 1N4448
C36 .18 200V
R72 4.75K
R71 21.5K ±1%, 1/8W
U1 LM339N
R76 37.4K
R74 590K
C37 1.0 100V
R77 10K ±5%, 1/4W
R79 10K ±5%, 1/4W
TP4
Q6 MPSA75
CR11 1N4448
R86 20M ±1%, 1/8W
C39 .01 100V
R80 10K ±5% 1/4W
R73 20M ±5%, 1/4W
R82 9.09K
R85 11.0K
R83 63.4K
R84 169K
P8 J8 J4
DOOR BD
RT1
TB2 J8
MV+ COM MA+ MA-
R1 1K ±.1% 1/8W
U2 LF411CN
R2 1K ±.1% 1/8W
R4 1K ±.1% 1/8W
R3 1K ± .1% 1/8W
J12 P12
GRY
GRN
RED
TPB TPA TPC TPD
J10 P10 P9 J9
SUSPENSION ASSY
DS1
T1
J9 P9
CR7 1N5060
CR8 1N5060
C32 2000 15V
TP3
TP2
R63 7.5K ±1%, 1/8W
R64 14K
R65 4530
VR3 1N935 9.0V
U7 LM308N
C33 33pf 500V
C35 .01, 100V
C34 .01 100V
Q4 MJE800
R66 1.0
Q5 2N3565
CR6 W04
J13 P13
C1 .1 50V
C2 .1 50V
GND
NEUT
120V RMS
HOT TB1
F1 .75 AMP 120V
TP1
F3
R55 700K ±1%, 1/8W
R59 700K ±1%, 1/8W
622351 BD ASSY
622356 BD ASSY
U6 LM308N
C29 .022 50V
R58 5M ±1%, 1/2W
R62 1K
CR12 1N4448
Q2 D40D5
Q3 2N3791
R56 149K ±1%, 1/8W
C30 33pf 500V
R61 2 ±5%, 5W
R60 100
C31 .01 100V
R88 5M ±1%, 1/2W
RT1
CAUTION
THIS DRAWING MAY NOT BE REVISED WITHOUT PRIOR WRITTEN APPROVAL OF THE INDICATED AGENCIES.
UL PTB FM BASEEFA CSA
GND NEUT HOT F1 .5 AMP
OPTIONAL 240V WIRING
VR1 140A +15V
VR2 120K -15V
C25 1500 40V
C41 .33 50V
C27 10 20V
C43 .1 50V
TP5
C26 1500 40V
C42 .33 50V
C28 10 20V
C44 .1 50V
CR5 W04
RESET NC NO COM RESET NO NC COM
CR2 1N5060
K2 K1
CR1 1N5060
ALARM RELAYS
J5
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE IN OHMS ±1%, 1/4 W.
2. ALL CAPACITORS ARE IN MICROFARADS.
CHG. E.O. NO. DATE BY CHK
J 15247 11-30-83 GS
K 13574 2-27-91 LA RG
QTY ITEM PART NO. DESCRIPTION
MATERIAL
FINISH
DR FRANKLIN 8-83
CHK 9-83
DSGN
ENGR
Rosemount Analytical Inc.
TITLE
DIAGRAM, SCHEMATIC - MASTER BOARD ASSY (CASE)
E SIZE
DWG NO. 020-617186
SCALE — INITIAL USE 755A SHEET 1 OF 1
F 04342 10-82

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF ROSEMOUNT ANALYTICAL INC. AND IS TENDERED SUBJECT TO THE CONDITIONS THAT THE INFORMATION (A) BE RETAINED IN CONFIDENCE, (B) NOT BE REPRODUCED OR COPIED IN WHOLE OR IN PART AND (C) NOT BE USED OR INCORPORATED IN ANY PRODUCT EXCEPT UNDER AN EXPRESS WRITTEN AGREEMENT WITH ROSEMOUNT ANALYTICAL INC.

CHG.	E.O. NO.	DATE	BY	CHK
A	10416			
B	10728	12-85	SS	AC
C	13048	10-11-90	LA	RG
D	13227	11-21-91	BF	LA
E	19120	4-17-00	LA	
F	19277	9-19-00	LA	



CAUTION
THIS DRAWING MAY NOT BE REVISED WITHOUT PRIOR WRITTEN APPROVAL OF THE INDICATED AGENCIES.
UL PTB BASEEFA
FM CE NAMUR
CSA TUV

( ) DENOTES ALTERNATE PART PIN NUMBERS FOR U3.
2. CAPACITOR VALUES ARE IN MICROFARADS.
1. RESISTOR VALUES ARE IN OHMS, 1%, 1/4W.
NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL	UNLESS OTHERWISE SPECIFIED	QTY	ITEM	PART NO.	DESCRIPTION
FINISH	DIMENSIONS ARE IN INCHES				

TOLERANCES
.X ± .050 ANGULAR ± 0° 30′
.XX ± .020 125 MACH. SURF. √
.XXX ± .005
THREADS: CLASS 2A OR 2B
REMOVE BURRS & SHARP EDGES .020 MAX.
MACH. FILLET RADIUS .020 MAX.
MACH. SURF. FLAT WITHIN .001 IN./IN.
OTHER SURF. FLAT WITHIN .005 IN./IN.
CONCENTRICITY MACH. SURF.
T.I.R. WITHIN 1/2 SUM OF DIAS. TOLS., .001 MIN.
DO NOT SCALE DRAWING

	BY	DATE
DR	S. SYNN	1/85
CHK	[illegible]	5/85
DSGN		
ENGR	R. Libiam	5/85

Rosemount Analytical Inc. [redacted]

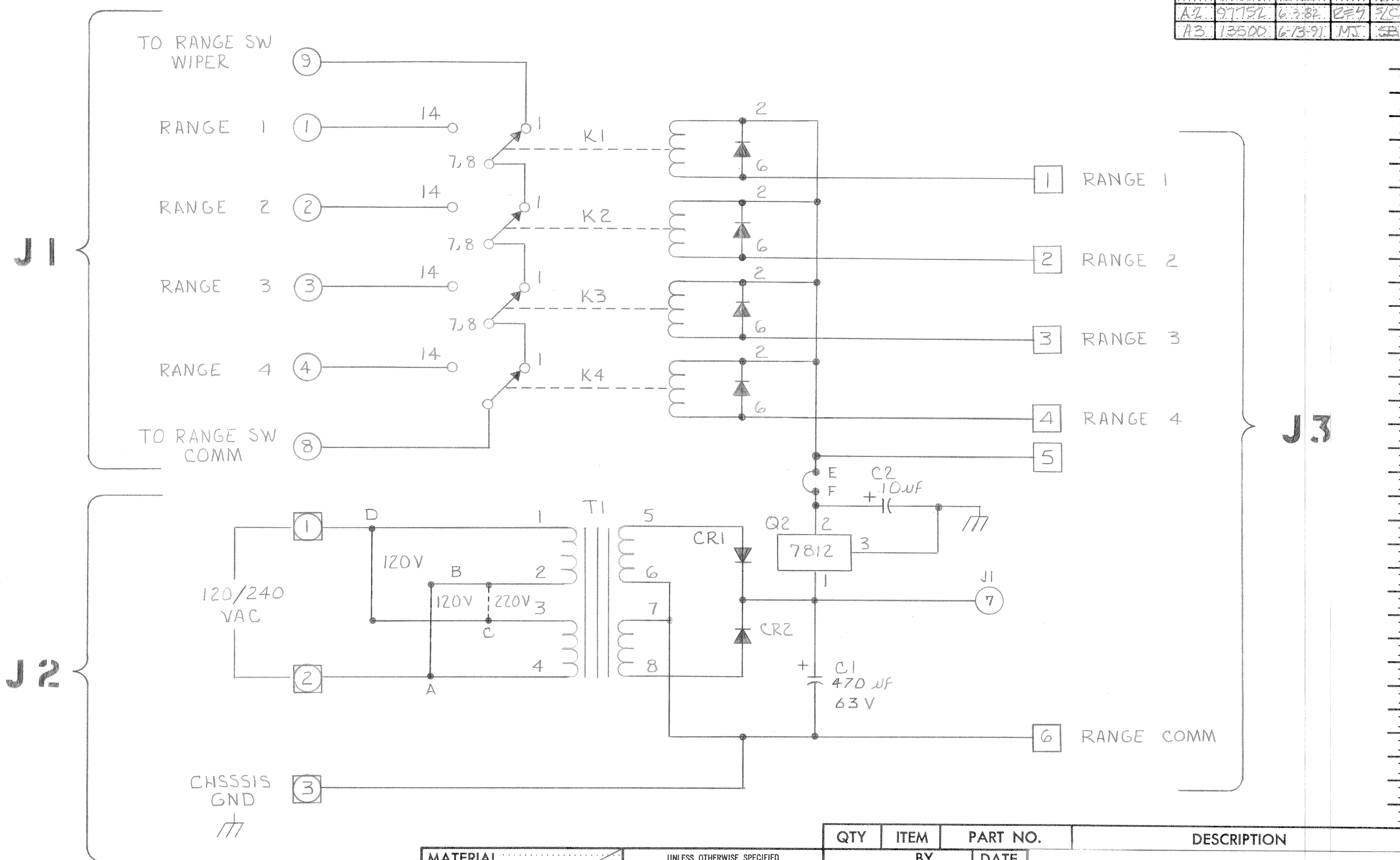
TITLE
DIAGRAM, SCHEMATIC – ISOLATED V/I BOARD

SIZE D | CODE IDENT NO. | DWG NO. 020 – 620434

SCALE — | INITIAL USE 400A | SHEET 1 OF 1

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF ROSEMOUNT ANALYTICAL INC. AND IS TENDERED SUBJECT TO THE CONDITIONS THAT THE INFORMATION (A) BE RETAINED IN CONFIDENCE, (B) NOT BE REPRODUCED OR COPIED IN WHOLE OR IN PART AND (C) NOT BE USED OR INCORPORATED IN ANY PRODUCT, EXCEPT UNDER AN EXPRESS WRITTEN AGREEMENT WITH ROSEMOUNT ANALYTICAL INC.

CHG.	E.O. NO.	DATE	BY	CHK
A	90133			
A1	94149	2-23-81	VJ	[illegible]
A2	97752	6-3-82	[illegible]	[illegible]
A3	13500	6-13-91	MJ	SB



MATERIAL	FINISH

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES
.X ± .050
.XX ± .020
.XXX ± .005
ANGULAR ± 0° 30′
MACH. SURF. 125
THREADS: CLASS 2A OR 2B
REMOVE BURRS & SHARP EDGES .020 MAX.
MACH. FILLET RADIUS .020 MAX.
MACH. SURF. FLAT WITHIN .001 IN./IN.
OTHER SURF. FLAT WITHIN .005 IN./IN.
CONCENTRICITY MACH. SURF.
T.I.R. WITHIN 1/2 SUM OF DIAS. TOLS., .001 MIN.
DO NOT SCALE DRAWING

QTY	ITEM	PART NO.	DESCRIPTION

	BY	DATE
DR	J. BRIGHT	6/79
CHK		
DSGN	J. KEEGAN	10-79
ENGR		
APPD		

Rosemount Analytical Inc. ROSEMOUNT ANALYTICAL INC. LA HABRA, CALIFORNIA 90631

TITLE: DIAGRAM, SCHEMATIC RANGE BD.

SIZE: C | CODE IDENT NO. | DWG NO. 020 — 646090

SCALE — | INITIAL USE 864 | SHEET 1 OF 1

27-70.27.6

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL CAPACITORS ARE MICROFARADS, 50V.
2. ALL RESISTORS ARE IN OHMS, ±1%, 1/8W.

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF ROSEMOUNT ANALYTICAL INC. AND IS TENDERED SUBJECT TO THE CONDITIONS THAT THE INFORMATION (A) BE RETAINED IN CONFIDENCE, (B) NOT BE REPRODUCED OR COPIED IN WHOLE OR IN PART AND (C) NOT BE USED OR INCORPORATED IN ANY PRODUCT, EXCEPT UNDER AN EXPRESS WRITTEN AGREEMENT WITH ROSEMOUNT ANALYTICAL INC.

CHG	E.O. NO.	DATE	BY	CHK	ENGR
A	REL	11/8/90			
B	13208	2/18/91	GS	BG	
C	16179	10/18/93	TL		

BY		DATE
DR	A. A. ROJO	10/1/90
CHK	ANDERSON	12/90
DSGN		
ENGR	J.RUSSELL	12/21/90
	J.B.SIMPSON	12/90

Rosemount Analytical Inc. ROSEMOUNT ANALYTICAL INC. LA HABRA, CALIFORNIA 90631

TITLE
DIAGRAM, SCHEMATIC-CONTROL BOARD-755R

D SIZE | CODE IDENT NO. | DWG NO. 020—652826

SCALE NONE | INITIAL USE 755R | SHEET 1 OF 1

D SIZE 020—652826 DWG. NO.

CHG	E.O. NO.	DATE	BY	CHK	ENGR
H	17377	3/29/96	LA	JB	JR
J	17023	08/12/96	KV		

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF ROSEMOUNT ANALYTICAL INC. AND IS TENDERED SUBJECT TO THE CONDITIONS THAT THE INFORMATION (A) BE RETAINED IN CONFIDENCE, (B) NOT BE REPRODUCED OR COPIED IN WHOLE OR IN PART AND (C) NOT BE USED OR INCORPORATED IN ANY PRODUCT, EXCEPT UNDER AN EXPRESS WRITTEN AGREEMENT WITH ROSEMOUNT ANALYTICAL INC.

2. FAN COLOR CODES VARY WITH MANUFACTURE. USE COLOR CODE THAT APPLIES.

WIRE NO.	FAN A	FAN B
1	BRN	BRN
2	BLU	BLU
3	YEL	BLK
4	GRN	GRY

1. UNITS WITH 230V OPTION AND REMOTE RANGE SELECTION REQUIRE RANGE BOARD (P/N 646004) JUMPER CONFIGURATION CHANGED FROM A TO B AND C TO D, TO B TO C.

	BY	DATE
DR	A. A. ROJO	10/1/90
CHK	ANDERSON	12/90
DSGN		
ENGR	S. SALIMIAN	12/90
	J.B. SIMPSON	12/90

Rosemount Analytical Inc. ROSEMOUNT ANALYTICAL INC. LA HABRA, CALIFORNIA 90631

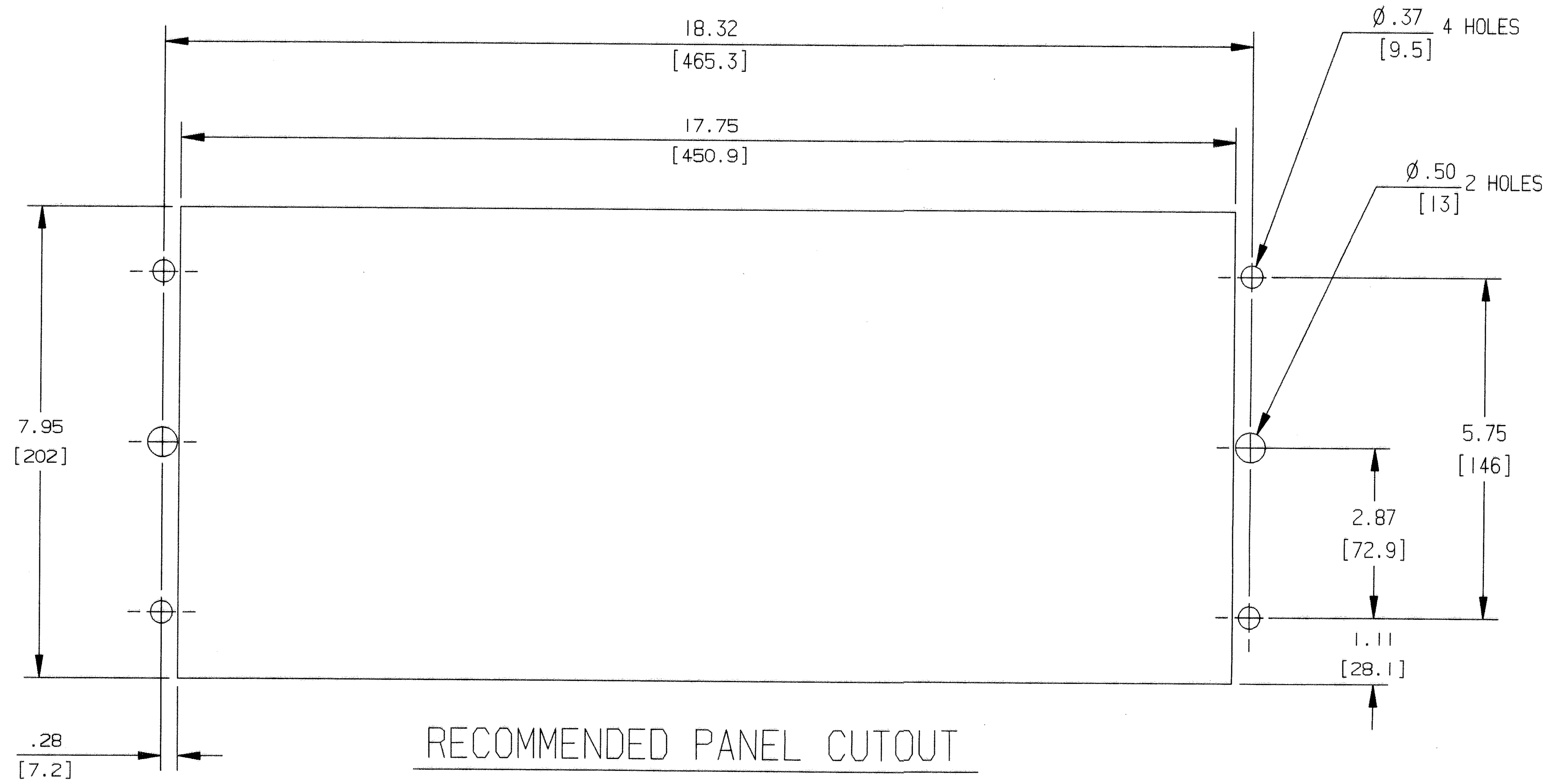
TITLE
DIAGRAM, PICTORIAL WIRING
PARAMAGNETIC O2 ANALYZER
MODEL 755R

SIZE D | DWG NO. 654014

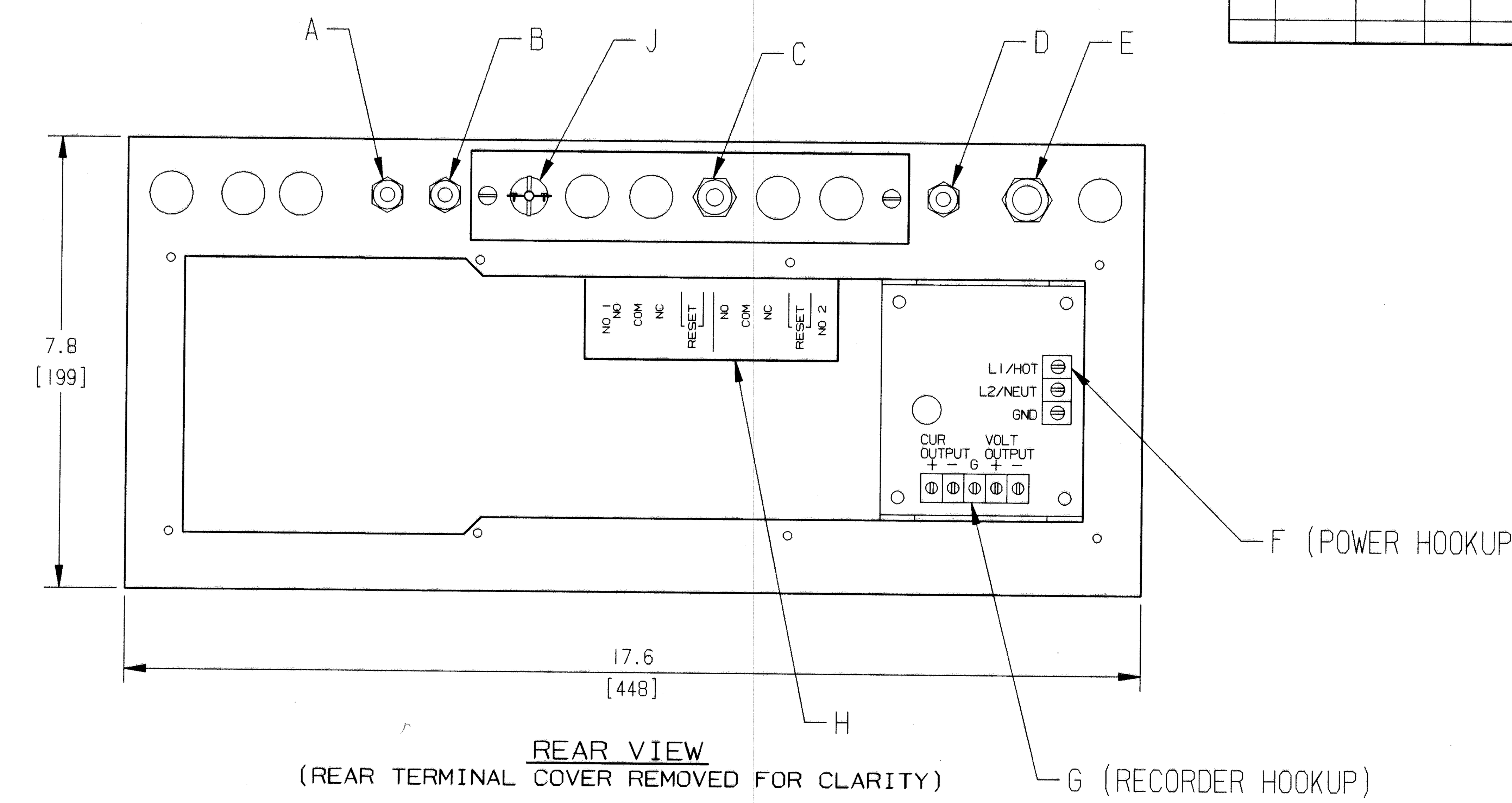
SCALE NONE | INITIAL USE 755R | SHEET 1 OF 1

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATON OF ROSEMOUNT ANALYTICAL INC. AND IS TENDERED SUBJECT TO THE CONDITIONS THAT THE INFORMATION (A) BE RETAINED IN CONFIDENCE, (B) NOT BE REPRODUCED OR COPIED IN WHOLE OR IN PART AND (C) NOT BE USED OR INCORPORATED IN ANY PRODUCT EXCEPT UNDER WRITTEN AGREEMENT WITH ROSEMOUNT ANALYTICAL INC.

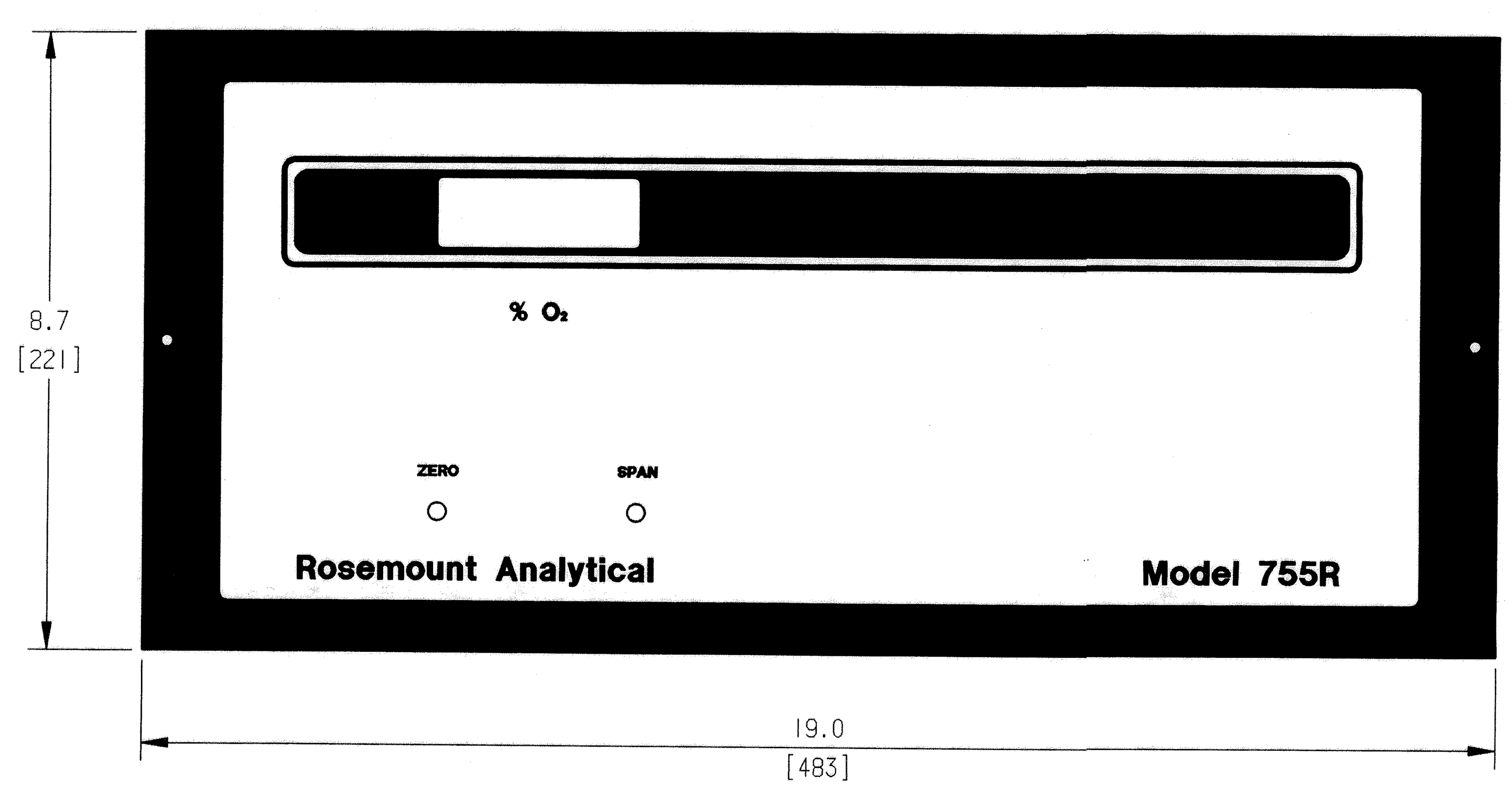
CHG	E.O. NO.	DATE	BY	CHK	ENGR
E	16170	10/06/93	DFH	JB	JR
F	16251	01/06/93	DFH		

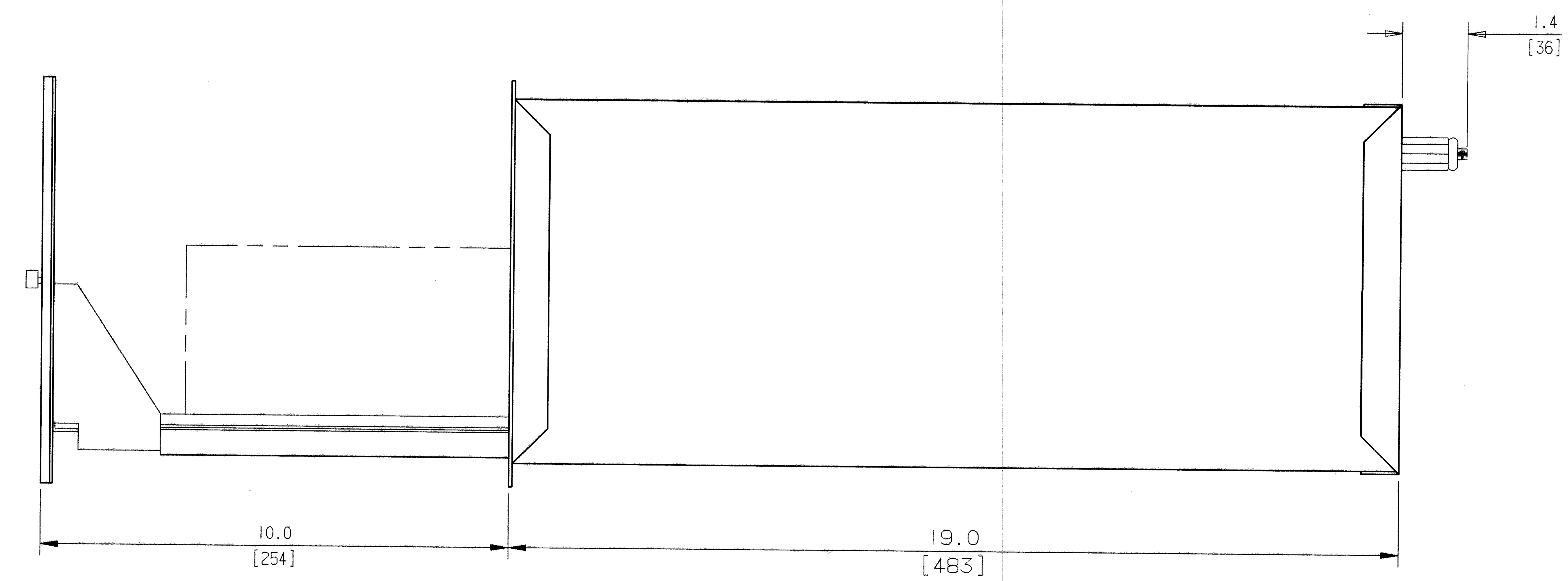


RECOMMENDED PANEL CUTOUT



REAR VIEW
(REAR TERMINAL COVER REMOVED FOR CLARITY)





J. OPTIONAL REMOTE RANGE CHANGE (SEE MANUAL FOR HOOKUP)

H. OPTIONAL ALARM ASSEMBLY CONNECTIONS. (SEE MARKINGS OR MANUAL FOR CONTACT RATINGS).

G. TB2, CUSTOMER HOOK-UP FOR RECORDER OUTPUT.

F. TB1, CUSTOMER HOOKUP FOR POWER (SEE NOTE 6).

E. .812 INCH DIA HOLE FOR POWER CABLE. IF MOUNTED IN UNPROTECTED RACK OR PANEL, WIRE POWER VIA 3-CONDUCTOR, 18 AWG MIN., CABLE IN CONDUIT OR ELECTRICAL METAL TUBING. IF MOUNTED IN A PROTECTED RACK OR CABINET OR ON A BENCH, AN ACCESSORY KIT, P/N 654008, IS AVAILABLE WHICH CONTAINS A 10-FT NORTH AMERICAN CORD SET AND LIQUID-TIGHT FEED THRU GLAND FOR THIS HOLE. THIS KIT ALSO CONTAINS FOUR ENCLOSURE SUPPORT FEET FOR BENCH TOP USE.

D. ONE .625 DIA HOLE FOR RECORDER OUTPUT CABLE FITTED WITH LIQUID TIGHT GLAND FOR .187 INCH TO .312 INCH DIA. CABLE. (CABLE SUPPLIED BY CUSTOMER. 2 CONDUCTOR. MIN 18 AWG).

C. ONE .625 DIA HOLE FOR DUAL ALARM OPTION CABLE FITTED, WHEN ORDERED, WITH LIQUID TIGHT GLAND FOR .187 INCH TO .312 INCH DIA. CABLE. (CABLE SUPPLIED BY CUSTOMER, MINIMUM 24 AWG).

B. SAMPLE INLET, .25 INCH TUBE FITTING.

A. SAMPLE OUTLET, .25 INCH TUBE FITTING.

NOTES:

6. POWER REQUIREMENT: 115/230VAC, 50/60 HZ, AS SPECIFIED BY CUSTOMER. FACTORY SET.

5. ELECTRICAL INSTALLATION MUST BE IN COMPLIANCE WITH NATIONAL ELECTRICAL CODE (ANSI/NFPA 70) AND/OR ANY APPLICABLE NATIONAL OR LOCAL CODES.

4. FOR SAFETY AND EQUIPMENT PROTECTION, ALL UNUSED OPENINGS MUST BE PLUGGED WITH FACTORY INSTALLED PLUGS (OR EQUIVALENT).

3. INSTRUMENT IS NOT WEATHERPROOF.

2. APPROXIMATE WEIGHT: 46 LBS / 20.9 kg.

1. STANDARD 19 INCH RACK MOUNT.

DIMENSIONS
INCH
MILLIMETER

THIRD ANGLE PROJECTION

	BY	DATE
DR	D.RICHARDSON	9/27/90
CHK	ANDERSON	11/90
DSGN	N/A	
ENGR	S. SALIMIAN	1/28/90
	J.B. SIMPSON	1/28/90

Rosemount Analytical Inc. ROSEMOUNT ANALYTICAL INC. LA HABRA, CALIFORNIA 90631

TITLE
INSTALLATION DRAWING, RACK MOUNT-MODEL 755R

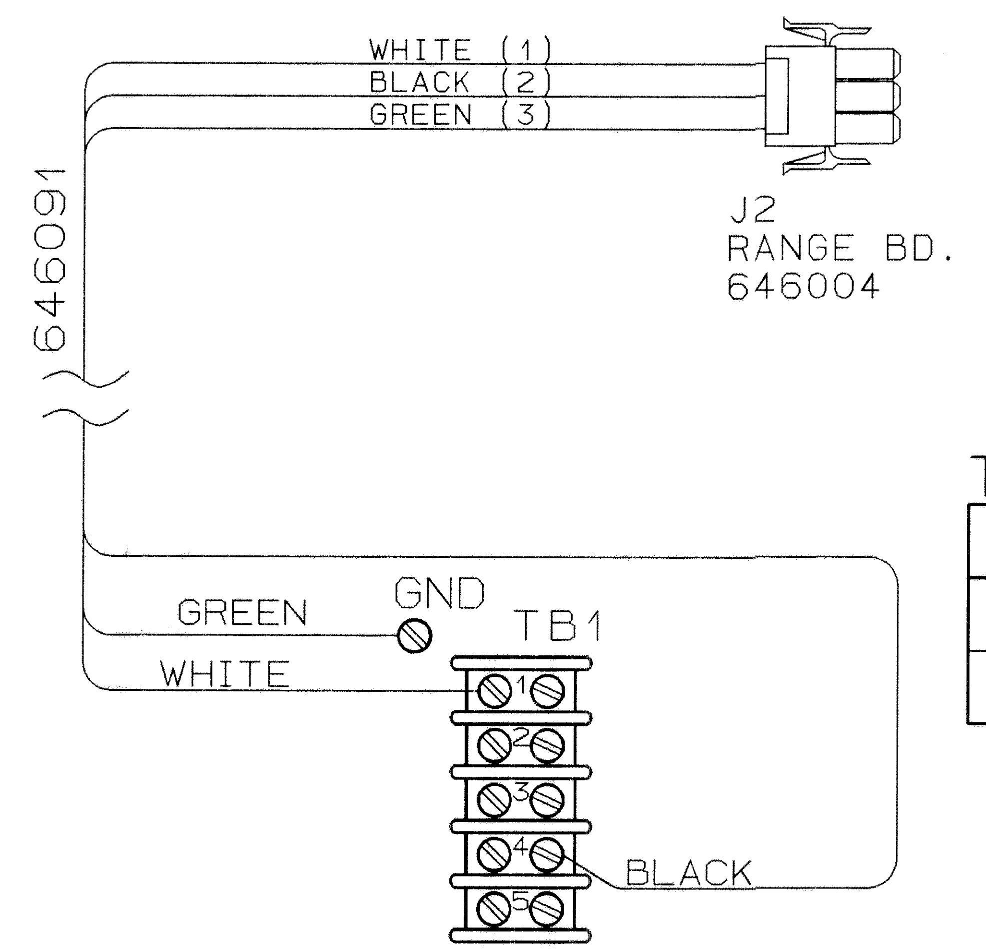
SIZE	CODE IDENT NO.	DWG NO.
D		010 - 654015

SCALE 1/2 | INITIAL USE 755R | SHEET 1 OF 1

D SIZE 010 - 654015 DWG. NO.

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF ROSEMOUNT ANALYTICAL INC. AND IS TENDERED SUBJECT TO THE CONDITIONS THAT THE INFORMATION (A) BE RETAINED IN CONFIDENCE, (B) NOT BE REPRODUCED OR COPIED IN WHOLE OR IN PART AND (C) NOT BE USED OR INCORPORATED IN ANY PRODUCT, EXCEPT UNDER AN EXPRESS WRITTEN AGREEMENT WITH ROSEMOUNT ANALYTICAL INC.

CHG	E.O. NO.	DATE	BY	CHK	ENGR
A	16125	9/9/93			
B	16251	12/20/93	DFH		



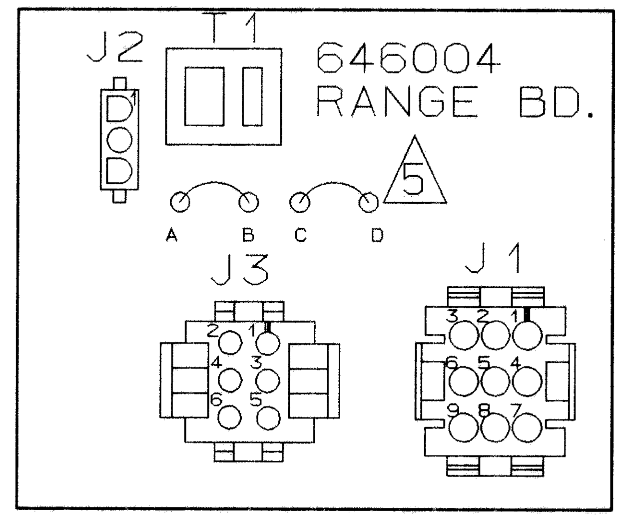
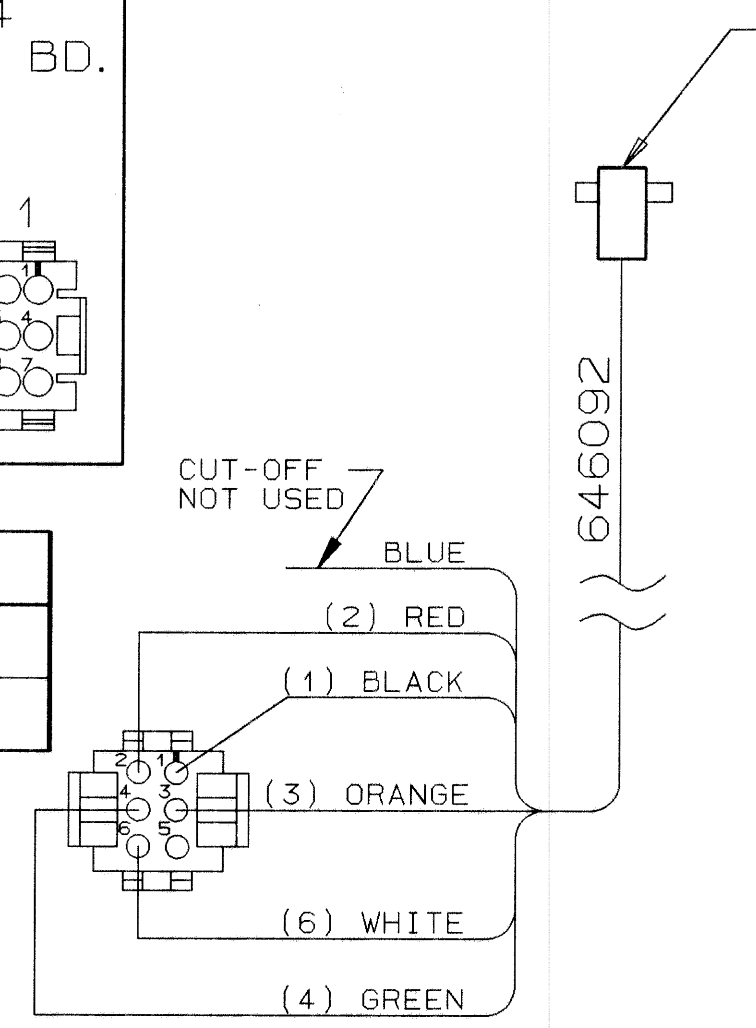


TABLE 2

INPUT POWER	JUMPERS
115V	A-B C-D
230V	B-C



MOUNT TO SMALL HOLE IN OPTION CONNECTION OF PLATE (P/N 655164)

SIGNAL	WIRE COLOR	PIN
RANGE 1	BLACK	A
RANGE 2	RED	B
RANGE 3	ORANGE	C
RANGE 4	GREEN	D
NOT USED	BLUE	E
COMMON	WHITE	F

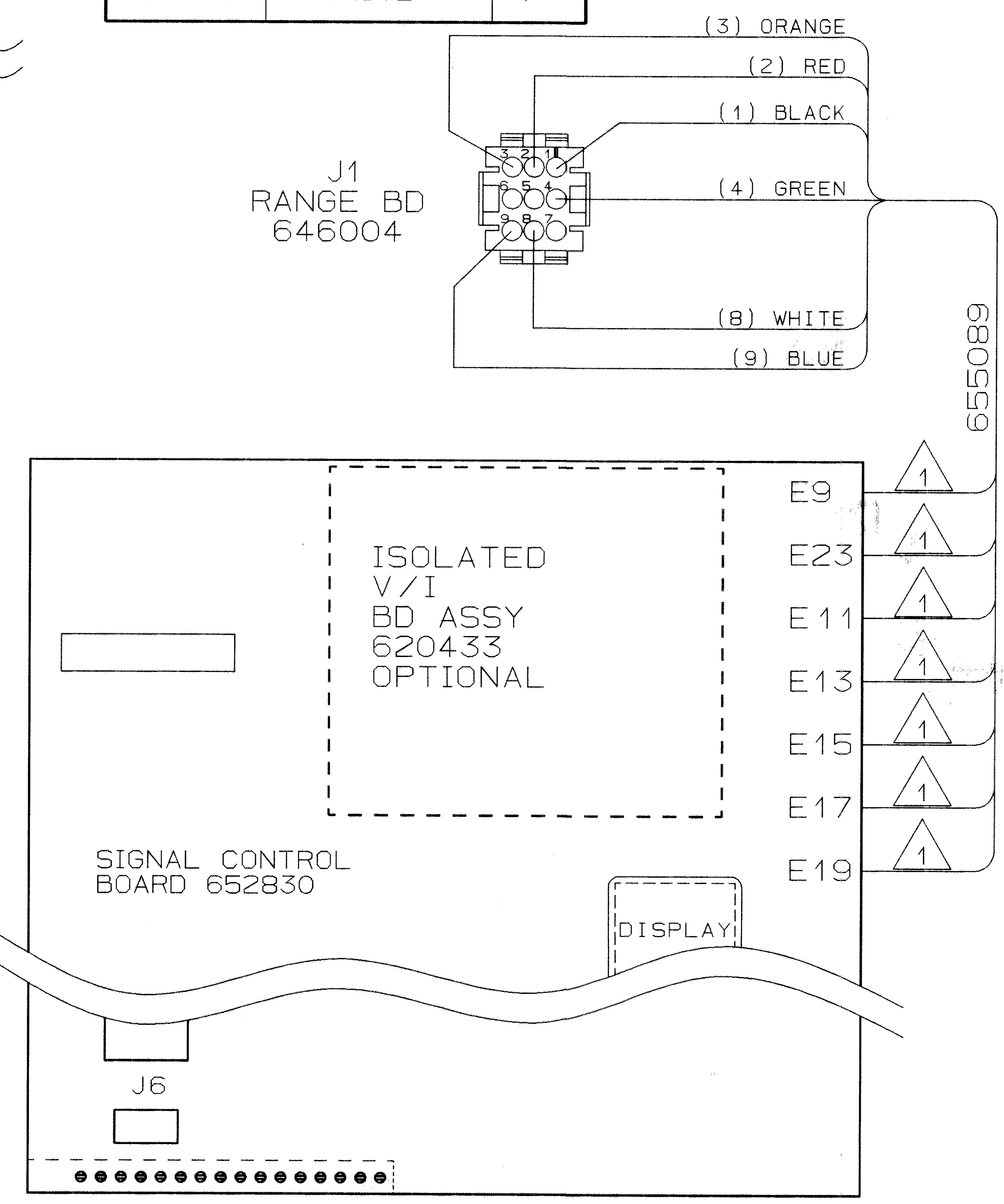


TABLE 1

PART NO.	RANGE	E9 100%	E23 50%	E11 25%	E13 10%	E15 5%	E17 2.5%	E19 1%
655093	0-5,10,25,50,100,% (STD RANGE SET UP)	BLU	GRN	ORN	RED	BLK	NC	NC
656323	0-1,2.5,5,10,25% (EXT)	NC	NC	BLU	GRN	ORN	RED	BLK
656324	0-1,2.5,5,10,50% (EXT)	NC	BLU	NC	GRN	ORN	RED	BLK
656325	0-1,2.5,5,25,50% (EXT)	NC	BLU	GRN	NC	ORN	RED	BLK
656326	0-1,2.5,5,25,100% (EXT)	BLU	NC	GRN	NC	ORN	RED	BLK
656327	0-1,2.5,10,25,100% (EXT)	BLU	NC	GRN	ORN	NC	RED	BLK

NOTES:

1. SEE TABLE 1 FOR CABLE CONNECTIONS.
2. RANGE SELECTION:

   AT THE TOP OF THE CONTROL BOARD P/N 652830 ARE TWO ROWS OF CONNECTOR PINS.
   THE TOP ROW E9, E23,...THRU E19 HAS PLUG IN CONNECTORS USED TO ACHIEVE THE DESIRED RANGE SELECTION.
   THE BOTTOM ROW E10, E24...THRU E20 ARE COMMON WITH ALL PINS CONNECTED TO EACH OTHER IN THAT ROW.
   THE WHITE WIRE OF CABLE P/N 655089 IS ALWAYS CONNECTED TO E10 OF THE BOTTOM ROW.
3. THE LETTERS "NC" ON TABLE 1 SIGNIFY "NO CONNECTION" THERE IS NO WIRE FROM CABLE P/N 655089 BEING USED FOR THAT RANGE SELECTION OPTION.
4. MOUNT RANGE BOARD P/N 646004 ON BRACKET P/N 654806 WITH POWER PLUG ON BOTTOM FACING REAR OF ENCLOSURE. (SEE DWG 654082 FOR ASSY INSTRUCTIONS).
5. THE RANGE BOARD IS SUPPLIED WITH 115V CONFIGURATION, FOR 230V OPTIONAL CONFIGURATION, REMOVE (CUT) JUMPERS A-B AND C-D. ADD JUMPER, ITEM 8, AT B-C (SEE TABLE 2).

	BY	DATE
DR	A. ROJO	9/9/93
CHK	DAN HAAK	9/15/93
DSGN	N/A	
ENGR	J. RUSSELL	9/27/93
	S. LIFSHUTZ	9/23/93

Rosemount Analytical Inc. ROSEMOUNT ANALYTICAL INC. LA HABRA, CALIFORNIA 90631

TITLE

INSTRUCTIONS-REMOTE RANGE SELECTION

SIZE C | DWG NO. 010-656081

SCALE NONE | INITIAL USE 755R | SHEET 1 OF 1